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FOR ALL INTERESTED IN CHEMICAL MANUFACTURES

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NOTICE.

Notice is hereby given that the resolution, embodied in the Report of Council to the Annual General Meeting, 1884, which forbids the publication of communications other than those read before the Society or its Sections, is now rescinded. Communications bearing upon Technical Chemistry can now be sent to the General Secretary, and, if they be approved by the Publication Committee, will be inserted in the Journal.

LIST OF MEMBERS ELECTED, JULY 7th, 1885.

C. A. Bolton, 10, Carlton Street, Nottingham, chemist.
C. D. Clifton, Royal Oak Brewery, Stockport, brewer.
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E. Francis, Rock Villas, Parkside, Nottingham, lecturer on chemistry.
F. Goddard, 1, Clipstone Avenue, Nottingham, ironfounder.
Evan R. Harris, Luckwell House, Bedminster, Bristol, ironworks manufacturer.
Adolph Hess, Oil Works, Leeds, chemical manufacturer.
G. F. Horner, Old Basford, Nottingham, bleacher.
G. T. Lewis, 231, South Front Street, Philadelphia, U.S.A. white lead manufacturer.
L. A. Lewis, 12, Crescent Place, Mornington Crescent, N.W., assistant analyst.
Sydney Lupton, M.A., The Harehills, near Leeds.
W. H. Parker, 177, Alfreton Road, Nottingham, pharmacist.
Beatus Petersen, 69, Nyhavn, Copenhagen, manager chemical works.
C. T. Richardson, Monkton Lodge, Jarrow-on-Tyne, alkali manufacturer.
John Thom, Birkacre, Chorley, Lancashire, calico printer.

LIST OF MEMBERS ELECTED JULY 23rd, 1885.

John Abbott, Braemar House, Lancaster Gate, Hyde Park, W., chemical manufacturer.
W. H. Aykroyd, Oakwood Villas, Toller Lane, Manningham, Bradford, dyeing chemist.
Oliphant A. Brown, Lennoxmill, Lennoxtown, N.B., printworks manager.
R. Jeff. Dodd, 195, Queen's Road, Dalston, N., chemist.
J. Emerson Dowson, 3, Great Queen Street, Westminster, S.W., M. Inst. C.E.
Anthony Edge, Readville, Mass., U.S.A., chemist.
E. H. Grimwade, Mildmay Chambers, 82, Bishopsgate Street, E.C., wholesale druggist.
Wm. Hammersley, Tar Works, Beckton, E., tar distiller.
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W. W. L. Lishman, 36, Washington Street, Girlington, Bradford, Yorks., dyeing chemist.
V. L. Lovibond, The Hermitage, North End, Fulham, S.W., brewer.
J. G. Flowerdew Lowson, Balthayock, Perthshire, N.B., paper maker.
Wm. Metcalf, Stanhill House, Oswaldtwistle, near Accrington, tar distiller.
Jno. Morrison, P.O. Box 71, North Adams, Mass., U.S.A., colour maker.
Arthur H. Newton, Belsize Court, Hampstead, N.W., colour manufacturer.
Gustav Quaas, Home Park Mills, King's Langley, Herts., paper maker and stainer.
J. S. Rooth, Walton Chemical Works, Chesterfield, manufacturing chemist.

J. Isaac Smith, 1, Norman Villas, Bath Road, Hounslow, sanitary inspector.

G. R. Underwood, Mass. Institute of Technology, Boston, Mass., U.S.A., assistant professor industrial chemistry.

Robt. Warington, Harpenden, Herts., analytical chemist.

Rowland Williams, 9, Albert Square, Manchester, analytical and consulting chemist.

T. Howell Williams, 10, Ascham Street, Kentish Town, N.W., manufacturing chemist.

David W. R. Wilson, Sinderby, Thirsk, Yorkshire, pharmacist.

J. W. Wyatt, Nash Mills, Hemel Hempstead, Herts., civil engineer.

CHANGES OF ADDRESS.

John Barrow (l/o Clayton), Helme House, Sandwich Road, Ellesmere Park, Eccles.

E. T. Brewis, 111, Great Brunswick Street, Dublin.

H. Brown (l/o Cumberland Market), Royal Oak Brewery, Stockport.

G. L. Cabot (l/o Boston), Readville, Mass., until October 31st, then c/o Chas. Almy, junr., Esq., 1, Brewster Place, Cambridge, Mass., U.S.A.

Jno. Cliff (l/o Wellington Street), Nesbitt Hall, Fulneck, Leeds.

H. P. Cooper (l/o Rectory Road), 15, Haringey Road, Hornsey, N.

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T. E. Vasey, 11, Corn Exchange Chambers, Mark Lane, E.C., and 6, South Parade, Leeds.

Death.

Jas. Higgin, l/o The Hollies, Timperley, Cheshire.

PROCEEDINGS OF THE FOURTH ANNUAL GENERAL MEETING,

Held at the City Guilds of London Central Institute, South Kensington, on Tuesday, July 7th, 1885.

Dr. W. H. Perkin, F.R.S., took the chair at eleven o'clock, and was supported by Mr. E. K. Muspratt (President elect), Mr. Walter Weldon, F.R.S.; Mr. J. C. Stevenson, M.P.; Sir Frederick Abel, C.B., D.C.L., F.R.S., and by representatives of the leading chemical firms throughout the United Kingdom. The minutes of the last Annual Meeting, held in Newcastle-upon-Tyne, were read and confirmed.

The Secretary read the following Report of the Council:—

REPORT OF THE COUNCIL.

Four years have passed since the inaugural meeting of the Society of Chemical Industry, and it is not possible to bring forward a better proof of the success which has attended the Society in its efforts to advance all branches of applied chemistry, than the 2090 names now upon its register. Since the last Annual Meeting at Newcastle, 345 new members have been elected, and 60 have been removed by various causes. The Council has to regret the death of 14 members, of whom the following demand special mention:—Dr. August Voelcker, so well known for his important contributions to the chemistry of agriculture; Sidney Gilchrist Thomas, whose name is identified with the basic process of steel-making; G. W. Wigner, founder and president of the Society of Public Analysts; Dr. Adrian Blaikie, Inspector of Alkali Works for the Tyne District; and Geo. H. Herbert, an enthusiastic supporter of the Society from the outset, and one of the principal merchants of Tyneside.

Two new sections have been established this year—one at Nottingham, under the chairmanship of Professor Clowes; and one for the West of England and South Wales, over which Professor Ramsay, of Bristol, has been elected to preside. The papers and discussions during the past session have reached a total of seventy-one, to which Birmingham has contributed three, Glasgow fifteen, Liverpool six, London seventeen, Manchester thirteen, Newcastle sixteen, and Nottingham one. The Bristol and South Wales Section is only just formed. It has not yet held any meetings.

The Council has felt it desirable that every endeavour should be made to keep the Journal from becoming unnecessarily voluminous, both for the sake of the readers and from motives of economy. A sub-committee has been accordingly formed which has power to reduce shorthand notes of discussions, and it will also be within the province of this sub-committee to induce the authors of papers to make these papers as concise as possible before they are printed in the Journal. In fine, all communications for the Journal will be submitted to this committee in MS.; and in view of this arrangement the Council would, under exceptional circumstances, permit papers other than those read before the Sections, to appear in the Journal under the head of "Communications." In September last five numbers (February to June inclusive) of the first volume were reprinted, at a cost of £128, in response to a generally expressed wish. To this extra expense, and to the general cost of the Journal, must be ascribed a deficit as between receipts and expenditure in 1884 of £167, as will be seen from the Treasurer's report. There will be no reprinting this year; and a substantial increase in the number of members leads the Council to hope that there will be a small surplus.

At the end of last year the Executive Council of the International Inventions Exhibition invited the Society to assist in preparing a representative exhibit showing the progress of applied chemistry during the last quarter of a century. A committee was formed with Mr. Ludwig Mond as honorary secretary, and members were invited to contribute. Twenty-seven responded favourably to the invitation, and a fine collection of chemical products and models, the result of their liberality, now forms the Society's collective exhibit.

Soon afterwards, at the instance of Sir Frederick Abel, the Executive Council of the Exhibition courteously resolved to grant season tickets to the Society's members at half-price, and under the terms of this arrangement 150 season tickets have been sold.

In conclusion, the Council would urge members to use their best endeavours to induce all those who are engaged in industrial chemistry, or whose business involves chemical engineering, to join the Society. The Council places reliance upon the usefulness of the work already done, and trusts that during the ensuing year the influence of the Society may be extended.

On the motion of Mr. Walter Weldon, seconded by Mr. E. K. Muspratt, it was resolved "That the Report of the Council now read be adopted."

The Treasurer read his Financial Statement for the year ending December 31st, 1884, a copy of which is appended.

SOCIETY OF CHEMICAL INDUSTRY.—TREASURER'S STATEMENT, DECEMBER 31st, 1884.

Dr.			£ s. d.
To Cash on Deposit (31st December, 1883)		£500 0 0	
Balance at Bank, ditto		423 13 3	
Ditto in Treasurer's hands, ditto		12 12 0	
Ditto in Secretary's hands, ditto		0 11 4	936 19 7
Annual Subscriptions:—			
6 for the year 1882		£6 6 0	
95 for the year 1883		99 4 6	
1695 for the year 1884		1,779 15 0	
52 for the year 1885		51 12 0	
1 for the year 1886		1 1 0	
1849 Amounts overpaid		1 17 0	1,942 15 6
Life Composition Fees			90 0 0
Interest on Deposit Account			18 11 5
Journal:—			
Advertisements		£182 5 0	
Sales	£361 2 0		
Less Publishers' Commission	53 17 10	307 4 2	489 9 2
			£3,477 18 8

Cr.			£ s. d.
By Journal Expenses:—			
Publishing		£1,313 19 3	
Editorial		443 10 4	1,787 9 7
Reprinting Volume I.			128 0 0
Printing Sundries			125 19 1
Sectional Expenses:—			
Newcastle Section		£23 7 0	
Liverpool Section		27 5 9	
Manchester Section		57 13 8	
Birmingham Section		11 0 2	
Glasgow Section		51 6 8	
London Section		52 8 1	226 1 4
Secretary's Salary			200 0 0
Honorarium voted to Secretary for extra work in 1883			25 0 0
Honorarium voted to Edward Hughes for assistance rendered to Hon. Treasurer in 1883			21 0 0
Office Furniture			9 8 0
Office Expenses:—			
Rent		£77 6 3	
Fires, Cleaning, Attendance, etc.		10 1 5	
Gas		0 8 11	
Sundries		1 8 4	89 4 11
Stationery			28 15 0
General Postage			8 1 3
Subscription Returned (paid twice)			1 1 0
Bank Charges on Scotch and Irish Cheques, etc.			1 6 0
Secretary's Petty Cash:—			
Carriage of Parcels, etc.		£1 5 6	
Postage, Telegrams, etc.		22 16 9	
Gratuities		1 11 0	
Travelling Expenses (including Expenses of Annual Meeting)		11 18 2	
Stationery		1 3 1	38 14 6
Treasurer's Petty Cash:—			
Stationery		£0 12 0	
Carriage of Parcels, etc.		0 6 8	
Postage		11 12 4	
Law Charges		0 6 0	
Fire Insurance Premium		0 2 6	12 19 6
Cash on Deposit (31st December, 1884)		£600 0 0	
Balance at Bank, ditto	£176 5 0		
Less Amount owing to Secretary, ditto	1 6 6	174 18 6	774 18 6
			£3,477 18 8

We have compared the above Statement with the receipts, counterfoils, vouchers and books of the Association, and certify it as correct.

14th February, 1885.

THEOBOLD, BROS. & MIALL, F.C.A.

Messrs. J. Robbins, London, and George Ward, Leeds, were appointed scrutators of the voting papers, which were then handed in, and the President declared the ballot closed.

The President then delivered the following address:—

THE PRESIDENT'S ADDRESS.

Taking a precedent from some of those who have occupied this chair before me, I have selected for my few remarks to-day the subject in relation to Technical Chemistry, with which I have been personally connected—namely, the colouring matters produced from coal-tar products, with some of the lessons its development appears to me to teach us in connection with industrial chemistry. Sir Frederick Abel, in his address in 1883, when speaking of the history of gunpowder, said that "It is one of the most remarkable features connected with the history of gunpowder, that until the last quarter of a century no radical changes should have been introduced into the manufacture and modes of applying this, the first known practically useful explosive agent." It appears to me that this is more or less true of all the older industries, which resulted simply from experiment and observation without any other basis to work from. They have had long histories in which little progress has been made, but of late years, owing to our advanced and rapidly increasing scientific knowledge, they are undergoing great, and in many cases radical changes.

The coal-tar colour industry stands in a very different position to our older ones. It has a sharply-defined origin, and a very short history dating back only to 1856, and it is not yet 29 years since the date of the first patent. It is an industry which has been founded on scientific discovery, and has developed side by side with it, being in fact a most important handmaid to research, which in its turn has repaid it by new discoveries. At the date of its introduction very little was known of the chemistry of colouring matters; they were always found difficult bodies to investigate, and when produced in reactions were generally regarded as secondary products, and every endeavour was made to get rid of them so that the other products associated with them might be examined; but now, owing to the very extended study which has been made of these bodies, on account of this industry, and the relationships which have been found to exist between the colour of the compounds and the chemical constitution, it is possible with more or less certainty to predict the colour a compound will have before it is produced, and the means which can be used to modify it.

It will be impossible for me to give you but a very brief sketch of the history of this industry in the time at my disposal; anything like a complete account would fill volumes. On account of this I shall not be able to refer except casually to the coal-tar industry itself, the development of which is nearly entirely due to the one under consideration. Nor can I give a consecutive account of the coal-tar colours themselves, because the discovery of new series of colouring matters, and the progress of old ones, necessarily produce overlapping as it were, and renders such a course difficult and confusing. I therefore propose to take them according to the groups we now know them to belong to. I will therefore commence with that which contains the first colouring matter connected with this industry—*i.e.*, the *mauveine* and *safranine* group of compounds.

As I already mentioned, the coal-tar colour industry dates from 1856, the discovery of the aniline purple or mauve dye being made during the Easter vacation of that year, and the patent for its production taken out on the 26th of the following August. From the accounts I have already given elsewhere, I have mentioned how the discovery of this colouring matter was made during the prosecution of scientific research, which had for its object the artificial production of quinine, a subject which of late has very much occupied the attention of chemists, though it has not as yet been accomplished.

When commencing this industry, which was looked upon by many with considerable doubt as to its practicability, the difficulties encountered were very numerous on account of its unique character, but few of the processes having their representatives in other industries, the products were also very valuable, so that great care had to be employed with them. Moreover, the success of the product tinctorially had not been proved on the large scale, so that it was necessary sary to proceed tentatively and not launch out too rapidly.

Aniline, as is well known, was at this period a rare body, originally obtained from indigo by Unverdorben in 1826; for its production from benzene we are first indebted to the discovery of nitrobenzene in 1834 by Mitscherlich, and then to Zinin, who found that this substance when submitted to certain reducing agents produced a base which was eventually identified as aniline. It was not long before the date of this industry that a method of producing this base from nitrobenzene, with greater ease than by the process of Zinin, was discovered; and it is to Béchamp we are indebted for this, who found that the reduction might be easily accomplished by means of iron filings and acetic acid. Had this discovery not been made, aniline could not have been produced sufficiently cheap to be used for the production of colouring matters. And it is interesting to note that this process of Béchamp, slightly modified, is the one used to-day for the production not only of this base, but its homologues and analogous compounds.

It was not long before the difficulties of producing nitrobenzene were to a great extent overcome. Messrs. Simpson, Maule & Nicholson also began to experiment on the production of nitrobenzene, and after a time were able to produce it at a sufficiently low cost to be able to supply us with part of our requirements. I mention this in passing because it was the starting point of the history of the connection of this firm with artificial production of colouring matter, which they carried on so successfully afterwards.

After the mauve was discovered it was necessary to teach dyers how to use it. Being an organic base, it is opposite in properties to the vegetable colouring matter, and therefore the ordinary methods of application were not generally useful, and much time had to be spent in dyehouses and printworks in the early days of this product in reference to this subject, and at that time the question of fastness to light, soap, and bleaching liquor was much insisted on. Fortunately for the future of the coal-tar colour industry, although the mauve would not resist bleaching liquor well, it proved to be a very fast colour—the fastest purple yet produced, I believe—and thus its introduction became rapid. After this the love of brilliancy of colour which it had induced caused less attention to be given to the subject of fastness. I quite think that had this, the first coal-tar colouring matter, yielded colours as fugitive as some which have since been used, this industry would probably have been, to say the least, much delayed in its progress; so that it will be seen the mauve had to bear all the burdens of the difficulties incident on the inauguration of this industry, the future products being free from these impediments. The importance of this colouring matter after its success was established was quickly recognised in France, and its manufacture commenced there. This soon resulted in its importation into this country irrespective of patent rights. As, however, the foreign manufacturer employed responsible agents in this country, the law was without difficulty put into operation successfully—unfortunately, however, only to teach Continental manufacturers the lesson not to employ responsible agents in this country any longer, but, by means of correspondence or travellers to deal directly with the consumers, and this *modus operandi* (practically, though perhaps not theoretically) enabled them to ignore the existence of patents, and import their products freely into this country. On this point I shall have to speak again further on. The mauve was first employed in silk dyeing in London, Messrs. Thomas Keith & Sons, of Bethnal Green, being the first to use it. The second application was calico printing, Messrs. James Black & Co., of Glasgow, being the first to employ it largely for this purpose. It afterwards was extended to other trades.

With reference to the chemical history of this dye, although it had been submitted to analysis very soon after its discovery, its formula, or rather the formula of its principal constituent "mauveine," was not established until some time after it had become a commercial product, and was prepared in a crystalline condition. It was then shown to have the composition $C_{27}H_{24}N_4$ (Proc. R. S. xiii. 170).

It was found to be a very powerful base, decomposing ammonia salts with evolution of ammonia, and combining with carbonic acid to form a carbonate. Its ordinary salts are produced by its combination with one molecule of a mono-basic acid, its hydrochloride having the formula $C_{27}H_{24}N_4HCl$.

In concentrated sulphuric acid mauveine dissolves with a dirty green colour, changing to blue on slight dilution, and back to purple when thoroughly diluted; this is a distinctive reaction of this class of colouring matters. Further researches have shown (*J. Chem. Soc.* xxxv. 717-732) that in the ordinary commercial product, besides mauveine, there are two other compounds, one possessing a redder shade of colour, the other being remarkable for its great solubility in alcohol. This latter from analysis appears to have the formula $C_{24}H_{20}N_4$.

The first product, or mauveine, is evidently a derivative of paratoluidine and aniline. The second of orthotoluidine and aniline, and the third of pure aniline. This has been called pseudo-mauveine. It might perhaps be better called pheno-mauveine.

When boiled with aniline mauveine yields an indigo-blue product, difficultly soluble in alcohol. This change takes place without formation of ammonia, and shows how different mauveine is in its character to rosaniline.

Runge found that aniline, when treated with dilute chloride of lime, yielded a blue or violet coloured solution, which soon underwent change. Some experiments on this, made in 1868 (*J. Chem. Soc.* xxii. 25-27), showed that the product which I named "Runge's blue," was a peculiar compound, the salt of an organic base, which itself dissolved in alcohol with a reddish brown colour, the salts being blue. It is quite different from mauveine, and of no practical value; but what is interesting is that when exposed to heat, as by boiling a solution of one of its salts, it decomposes with formation of mauveine.

A beautiful colouring matter was obtained from mauveine by treating it with ethyl iodide. It gives shades of colour of a very red purple tint, and it was therefore called *dahlia*. It was mostly used in calico delaine and other kinds of printing, but being costly, the production was never very large. This substance is a mono-ethyl derivative of mauveine, and all attempts to further ethylate this compound have proved fruitless. In properties it appears to be more like an ammonium compound than a displacement product.

Safranines.

In the preparation of mauveine, a colouring matter was obtained from the liquors, from which it was precipitated, yielding beautiful crimson-red shades of colour on silk. The amount produced in this was so small, however, that we were not able to introduce it as a dye. But it was found that it could be produced by the oxidation of the mauve dye itself, and was then manufactured under the name of "aniline pink," but afterwards "safranine." This substance is evidently closely related to mauveine, as it gives the characteristic reaction with sulphuric acid I have already referred to.

The preparation of this from the mauve dye was too costly to allow of its being brought into general use. However, new processes have been since discovered, by which this or other colouring matters of its class can be produced cheaply.

The first of these processes consisted in passing nitrous acid into commercial aniline, heating the mixture with arsenic acid, and then extracting the colouring matter produced. Hofmann examined this, and showed that it had the formula $C_{21}H_{20}N_4$ (*Ber.* vi. 526, 1872).

The examination of the product which was obtained by oxidising the mauve dye, I found to have the composition, $C_{20}H_{18}N_4$ (*J. Chem. Soc.* xxxv. 731), results which correspond with analyses published by Dale and Schorlemmer (*J. Chem. Soc.* xxxv. 682) obtained from the examination of a similar product. This substance, I also found, was associated with that examined by Hofmann in a product prepared by Messrs. Guinon & Co., of Lyons.

Methods of a more synthetical nature have since then been discovered. O. Witt found that safranine could be obtained from orthoazotoluene and hydrochloride of toluene at 150-200° (*Ber.* 10, 874, 1877). He then found that by oxidising a mixture of one part of paraphenylenediamine, and two parts of aniline, on the application of heat a safranine could be obtained which has the formula, $C_{18}H_{16}N_4$, and which is called phenosafranine.

The formation of this colouring matter by this and other processes has been studied by Nietzki (*Ber.* 16, 464). He finds that the aniline in the reaction, in which paraphenylenediamine takes part, may be substituted by other primary monamines, or a mixture of these with dimethylaniline, and thus a large number of these dyes can be obtained

Phenosafranine is now produced very largely, and in a pure crystallised condition, and is a very useful dyeing agent.

If we assume that all the safranines are strictly homologous compounds, the formula that Nietzki gives for phenosafranine would make the formula of that examined by Hofmann, and that examined by myself and Dale and Schorlemmer, to be incorrect, and that they should contain two hydrogens more than are assigned to them. This I cannot think is possible from all the analytical results we obtained.

The constitution of mauveine has not yet been established, and I have still experiments on this subject in hand. This may also be said of safranine, I think, although Nietzki has proposed a formula for it, in which nitrogen occupies a similar position to the methane-carbon in the rosaniline series.

Triphenylmethane Derivatives.

We must now go back again to the early days of this industry to consider the next class of compounds—viz., triphenylmethane derivatives.

The industrial success of the mauve dye caused aniline to become a very favourite body to experiment with, and the result was that in 1859 the discovery of that important colouring matter first known as fuchsine or magenta took place. Hofmann had observed in his experiments on the action of carbon tetrachloride on aniline in 1858, the formation of a red colouring matter, which consisted of this substance as a secondary product of the reaction, but it was M. Verguin who first discovered a process for the transformation of aniline into a red colouring matter of tinctorial value. The discovery of this compound marks a most important fresh departure in the history of coal-tar colours. As I mentioned, the mauve had paved the way for future colouring matters, and this new substance, which could be applied to fabrics by the same methods as the mauve, was most eagerly sought after owing to the brilliancy of its colour, and probably its manufacture was one of the most successful financially of all the aniline colours.

M. Verguin's process, which consisted in treating commercial aniline with tin tetrachloride, was soon superseded by better processes. The number of patents taken out for the production of this dye was very large, and all imaginable products were claimed as capable of producing it from aniline. The two most important, however, were those in which mercury nitrate and arsenic acid were used. The first of these processes, with which I had some experience, required much care to regulate the reaction and prevent deflagration. The next process with arsenic acid, known as Medlock's, was by far the best, and was employed very extensively until the last few years, the use of nitrobenzene as the oxidising agent being now mostly used in the place of arsenic acid.

The manufacture of magenta, which at this period was often called roseine, was carried on chiefly in this country by Messrs. Simpson, Maule & Nicholson, by the arsenic acid process. Mr. E. C. Nicholson and Dr. A. P. Price, of this firm, worked out the process with great success, and were the first to produce this colouring matter in a pure state. The beautiful display of the crystallised acetate, shown at the Exhibition of 1862, illustrated this fully.

It was with products supplied by Mr. Nicholson that Dr. Hofmann made his first researches on this colouring matter. He changed its name from roseine to *rosaniline*, and found that the base, when in combination with acids, had the formula $C_{20}H_{19}N_3$.

The important observation of Nicholson, and the critical experiments of *Hofmann, on the necessity of* using, not pure aniline, but a mixture of aniline and toluidine for the production of this substance, was made about this period.*

The next important step in this industry was the use of rosaniline itself as a source of new colouring matters. For this we are indebted to the experiments of two French chemists—viz., MM. Girard and Delaire, who discovered that rosaniline salts, when heated with aniline, gave violet and blue colouring matters, which they called *Violet Imperial* and *Bleu de Lyon*. It is, however, to Mr. Nicholson that the credit of producing these bodies, in a practically pure state, belongs. This especially refers to the blue, the product known as opal blue, used by Dr. Hofmann in his investigations on the subject, being of great purity. Dr. Hofmann showed that these products were phenylated rosanilines, as is now well known, ammonia being given off in the reaction. And I may mention in passing that the manufacture of these blues is now carried on to such a large extent that the ammonia produced in this reaction is collected for the production of its sulphate or other salt.

One of the difficulties in the way of the new blue was its insolubility in water. Mr. Nicholson, however (in 1862), probably thinking of the method used to render indigo soluble, experimented upon the action of sulphuric acid on this compound, and he found that it was possible to obtain sulphonic acids from it. One of these, the sodium salt of which is known as "Nicholson's" or "alkali blue," is the monosulphonic acid, which is itself insoluble in water, but forms soluble salts, which can be applied to the goods, and then decomposed by acids. This compound has had much to do with the successful introduction of this colouring matter. The other product known as soluble blue is the sodium salt of trisulphonic acid.

In the early part of 1864 the *Hofmann violets* were introduced. These, as is well known, are the ethylated rosanilines produced by acting upon rosaniline with ethyliodide. These colouring matters are more brilliant, though much more fugitive than mauveine; but by this time the desire for permanency was giving way very much to that of brilliancy; and these colouring matters were quickly taken up by dyers and calico printers.

About this time some colouring matters derived from phenol were introduced, and which, curiously, are found to belong to the class of substances now under consideration. These were brought forward by Messrs. Guinon, Marnas & Bonnet, of Lyons. The first product was aurin, prepared from phenol by means of oxalic and sulphuric acid (Kolbe and Schmitt's process). The next was *péonine*, obtained by acting upon aurin with ammonia. The third was *azuline*, prepared by heating aurin with aniline. This last was a blue dye, which has since been shown to consist chiefly of triphenylrosaniline.

Purple and violet derivatives were also obtained from rosaniline by a process of my own, in which brominated turpentine was employed. These were known as *Britannia violets*, and were much used.

Other coloured derivatives were also discovered; for example, by the action of aldehyde and sulphuric acid, a blue product was obtained, which, when treated with sodium hyposulphite or sulphuretted hydrogen water, yielded the well-known *aldehyde green*.

On examining the action of acetylchloride on Britannia violet, I obtained a peculiar green, which was used principally by calico printers, and very considerable quantities of acetylchloride were prepared for this purpose. The process was not published. This green was of a blue shade, and was obtained in a crystallised condition in combination with picric acid. The crystals had a golden metallic reflection.

Soon after this it was noticed that a green compound was produced in the preparation of the Hofmann violets, though generally only in small quantities. It was afterwards found that by making rosaniline react with an excess of methyl iodide that it could be produced practically. It was called *iodine green*; but the product now manufactured is a chloride. This colouring matter gave good candlelight greens. One of its peculiarities is that when heated it is converted into violet methyl-rosaniline, with loss of methyl-chloride.

A new method of producing rosaniline violet was proposed by Lauth, and patented by MM. Porrier and Chappat, in June, 1866. The process consisted in taking aniline, in which hydrogen had been replaced by an alcohol radical, and oxidising this instead of first preparing rosaniline, and then replacing the hydrogen in the colouring matter by the radical. The product proposed for this purpose was methylaniline.

Owing to the improved method of methylating aniline, which, I believe, was first proposed by Messrs. Girard and Delaire (*Bull. Chem. Soc.* [2], vii. 360), this process has become a very important one, and large quantities of dimethyl-aniline are now used, the oxidation being effected by copper salts. The product, according to the researches of Otto Fischer, consists chiefly of pentamethylpararosaniline.

The most important advance in the production of green colouring matters of the triphenyl-methane series was the discovery of the *Benzaldehyde, Victoria or Malachite green.*

In 1877, Otto Fischer, whilst investigating the condensation products of tertiary aromatic bases (*Ber.* x. 1625), obtained by the action of benzaldehyde on dimethyl-aniline in presence of chloride of zinc, a colourless base of the formula $C_{23}H_{26}N_2$, the salts of which, when exposed to the air, rapidly oxidised to a fine blue-green dyestuff, which, he thought, would prove to be of complicated constitution. A little later (*Ber.* xi. 950) he showed that by treating this colourless base with some of the ordinary oxidising agents, this green could be more easily produced, and that it stood to the colourless compound in the same way as rosaniline does to leucaniline. Emil and Otto Fischer afterwards say (*Ber.* xii. 796) that the first experiments for the production of this green were made by the Badische Anilin- und Soda-Fabrik, in March, 1878. About this time Oscar Doebner (*Ber.* xi. 950) found that a green colouring matter was produced by heating benzaldehyde with benzyl trichloride and zinc chloride. This product has been found to be identical with that of Fischer's. This green colouring matter is now largely made from benzaldehyde, as this process is found to be the best. A similar compound is also prepared from diethylaniline, and is known as brilliant green. It is a beautifully crystalline body. It is rather curious that this produces shades of colour somewhat yellower than the green from dimethyl-aniline, whereas, being of a higher molecular weight, we should have expected it to be bluer.

The principal difficulty which had to be contended with in the production of these colouring matters was the need of a supply of benzaldehyde. The usual method of obtaining it from bitter almonds, which was the only one in use, was quite out of the question, so that other sources had to be looked for. The Badische Anilin- und Soda-Fabrik, however, successfully overcame this difficulty. At first they experimented with the process of Lauth and Grimaux, which consists in the oxidation of benzyl-chloride, with an aqueous solution of lead nitrate; the product made by this process, however, was too dear. But they found that the decomposition of benzylidene-dichloride, by means of water, as observed by Cahours (*Ann. Chem. Suppl.* 2, 306) and Limpricht (*Ann. Chem.* 139, 316) gave them a means of producing this compound practically, the reaction being as follows :—

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* In my original patent it was shown that colouring matters could be obtained, not only from aniline, but also from toluidine, xylidine and cumidine—these bases, as usually prepared at that date from the hydrocarbons obtained by fractioning coal-tar naphtha, not being pure, but mixtures.

$$C_6H_5CHCl_2 + OH_2 = C_6H_5.CHO + 2HCl.$$

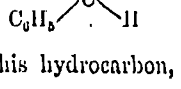
This process, which they have successfully employed since March, 1878, consists in the preparation of benzylidene dichloride from pure toluene, and in the subsequent treatment of this chlorinated body with milk of lime, at 100° C.

I have stated that the group of colouring matters under consideration are called triphenylmethane derivatives, and to show how this has been proved to be the case, I must now refer very briefly to some of the theoretical work which has led to this knowledge. The most important of this refers to rosaniline. I have already drawn attention to the work of Hofmann, which gave us the first knowledge of the composition of this colouring matter, and the further information that it contained hydrogen, which could be displaced by phenyl and alcohol radicals; but as to the matter of constitution, I think the experiments of Caro and Wanklyn were the first, as they showed the relation which existed between rosaniline and aurine, or rosolic acid, and, in fact, they produced rosolic acid from rosaniline; but it is to the beautiful researches of Emil and Otto Fischer that we are indebted for a clear knowledge of the constitution of this class of colouring matter.

But to clear the ground before proceeding further, I must remind you that ordinary commercial rosaniline, or magenta, prepared from aniline and toluidines, is a mixture of colouring matters. This was first known by Mr. Nicholson, who found that for the production of the finest blues it was necessary to purify the base and separate one of these before phenylating; but it is only of later years that the difference between these bodies has been carefully studied and explained. The base examined by Hofmann contained C_{20}, and is the chief constituent of commercial rosaniline. The other contains C_{19}, and is now called pararosaniline, because it is produced from aniline and paratoluidine. Similarly, in commercial aurin, two compounds are found, one containing C_{20}, now called rosolic acid, and one containing C_{19}, now called aurin; and these latter can be produced from the corresponding rosanilines; and Dale and Schorlemmer have also shown that aurin can be also converted into pararosaniline, by the action of ammonia (*J. Chem. Soc.* xxxii. 121).

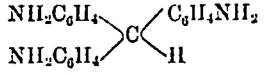
Emil and Otto Fischer, however, by submitting the leuco compound of commercial rosaniline to the diazo reaction, obtained the hydrocarbon $C_{20}H_{18}$, and from rosaniline prepared from paratoluidine and aniline the hydrocarbon $C_{19}H_{16}$.

And this latter hydrocarbon was found to be identical with Kekulé's triphenylmethane—



$$\begin{matrix}C_6H_5\\ C_6H_5\end{matrix}>C<\begin{matrix}C_6H_5\\ H\end{matrix}$$

On nitrating this hydrocarbon, they obtained a trinitro derivative, which, when reduced, gave the tri-amido body,

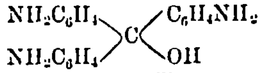


$$\begin{matrix}NH_2C_6H_4\\ NH_2C_6H_4\end{matrix}>C<\begin{matrix}C_6H_4NH_2\\ H\end{matrix}$$

which is paraleucaniline, and by carefully heating its hydrochloride to 150-160°, it was converted into pararosaniline.

Also they found that by oxidising trinitrotriphenylmethane they obtained trinitrotriphenylcarbinol, and this when reduced gave pararosaniline direct.

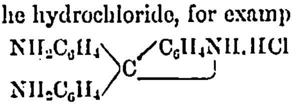
From these results the constitution of the base is evidently—



$$\begin{matrix}NH_2C_6H_4\\ NH_2C_6H_4\end{matrix}>C<\begin{matrix}C_6H_4NH_2\\ OH\end{matrix}$$

Pararosaniline.

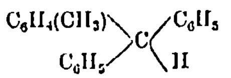
The salts—the hydrochloride, for example—being



$$\begin{matrix}NH_2C_6H_4\\ NH_2C_6H_4\end{matrix}>C<\begin{matrix}C_6H_4NH.HCl\\ \rule{2cm}{0.4pt}|\end{matrix}$$

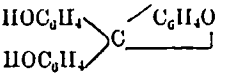
Pararosanilinehydrochloride.

Similar results were obtained from the hydrocarbon from rosaniline; it is tolyldiphenylmethane :—



$$\begin{matrix}C_6H_4(CH_3)\\ C_6H_5\end{matrix}>C<\begin{matrix}C_6H_5\\ H\end{matrix}$$

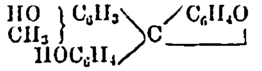
The rosolic acid and aurin corresponding to the rosanilines are constituted in an analogous manner :—



$$\begin{matrix}HOC_6H_4\\ HOC_6H_4\end{matrix}>C<\begin{matrix}C_6H_4O\\ \rule{2cm}{0.4pt}|\end{matrix}$$

Aurin.

and

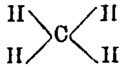


$$\begin{matrix}\left.\begin{matrix}HO\\ CH_3\end{matrix}\right\}C_6H_3\\ HOC_6H_4\end{matrix}>C<\begin{matrix}C_6H_4O\\ \rule{2cm}{0.4pt}|\end{matrix}$$

Rosolic acid.

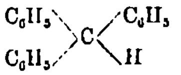
From these results we see the beautiful relationships of the various colouring matters of this series to each other, and by it obtain information which is of practical value, as well as theoretical. The following formulæ of a few of these products further illustrate this :—

Methane (Marsh Gas)



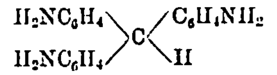
$$\begin{matrix}H\\ H\end{matrix}>C<\begin{matrix}H\\ H\end{matrix}$$

Triphenylmethane



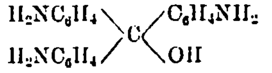
$$\begin{matrix}C_6H_5\\ C_6H_5\end{matrix}>C<\begin{matrix}C_6H_5\\ H\end{matrix}$$

Leucopararosaniline



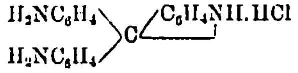
$$\begin{matrix}H_2NC_6H_4\\ H_2NC_6H_4\end{matrix}>C<\begin{matrix}C_6H_4NH_2\\ H\end{matrix}$$

Pararosaniline



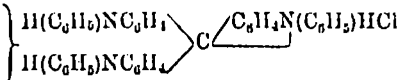
$$\begin{matrix}H_2NC_6H_4\\ H_2NC_6H_4\end{matrix}>C<\begin{matrix}C_6H_4NH_2\\ OH\end{matrix}$$

Pararosaniline hydrochloride



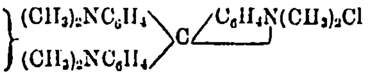
$$\begin{matrix}H_2NC_6H_4\\ H_2NC_6H_4\end{matrix}>C<\begin{matrix}C_6H_4NH.HCl\\ \rule{2cm}{0.4pt}|\end{matrix}$$

Triphenylpararosaniline hydrochloride (Aniline Blue)



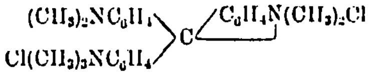
$$\begin{matrix}H(C_6H_5)NC_6H_4\\ H(C_6H_5)NC_6H_4\end{matrix}>C<\begin{matrix}C_6H_4N(C_6H_5)HCl\\ \rule{2cm}{0.4pt}|\end{matrix}$$

Hexamethylpararosaniline (Methyl Violet)



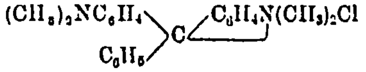
$$\begin{matrix}(CH_3)_2NC_6H_4\\ (CH_3)_2NC_6H_4\end{matrix}>C<\begin{matrix}C_6H_4N(CH_3)_2Cl\\ \rule{2cm}{0.4pt}|\end{matrix}$$

Methyl Green



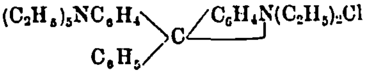
$$\begin{matrix}(CH_3)_2NC_6H_4\\ Cl(CH_3)_3NC_6H_4\end{matrix}>C<\begin{matrix}C_6H_4N(CH_3)_2Cl\\ \rule{2cm}{0.4pt}|\end{matrix}$$

Benzaldehyde or Victoria Green



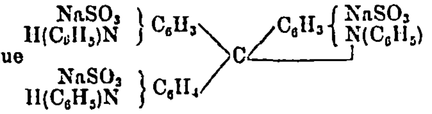
$$\begin{matrix}(CH_3)_2NC_6H_4\\ C_6H_5\end{matrix}>C<\begin{matrix}C_6H_4N(CH_3)_2Cl\\ \rule{2cm}{0.4pt}|\end{matrix}$$

Brilliant Green



$$\left.\begin{array}{l}(C_2H_5)_5NC_6H_4\\ C_6H_5\end{array}\right\rangle C\left\langle C_6H_4N(C_2H_5)_2Cl\right.$$

Soluble Blue



$$\left.\begin{array}{l}\left.\begin{array}{r}NaSO_3\\ H(C_6H_5)N\end{array}\right\}C_6H_3\\ \left.\begin{array}{r}NaSO_3\\ H(C_6H_5)N\end{array}\right\}C_6H_4\end{array}\right\rangle C\left\langle C_6H_3\left\{\begin{array}{l}NaSO_3\\ N(C_6H_5)\end{array}\right.\right.$$

The effect of displacing hydrogen by hydrocarbon radicals in rosaniline is seen to result in the shade of colour becoming bluer for each hydrogen displaced—the effect of those of high molecular weight, such as phenyl, being to produce the greatest change; thus triphenylrosaniline is blue, whilst hexamethylrosaniline is blue-violet, notwithstanding it contains six hydrogens displaced.

After all the displacements possible have been effected, as in hexamethylrosaniline, the result of the combination of the products with halogen compounds of methyl is very interesting. The particular group to which this is attached becomes of the nature of an ammonium, and the colour does not become bluer, but changes to green—*i.e.*, methyl green,—and this, like other ammonium compounds, when heated, dissociates, with loss of the halogen compound of methyl, and then hexamethylrosaniline is reproduced. Again, if this ammonium group be substituted by phenyl, we also get a green product—*i.e.*, Victoria green.

The structure of some of these bodies has been proved by another most beautiful synthetical process, which has lately come into use—a process which enables us now not only to say that we employ the volatile products of the distillation of coal, but also the coke itself; as carbonic oxide in combination with chlorine, phosgene or carbon oxychloride, is one of the important agents used. This substance was discovered in 1812 by J. Davy.

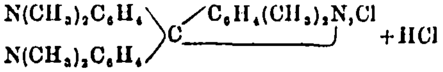
In 1876, W. Michler gave an account of his researches on the synthesis of aromatic ketones by means of phosgene (*Ber.* ix. 716), in which he showed by the action of this substance on dimethylaniline that a tetramethylated diamidobenzophenone was obtained. This substance has, therefore, the constitution—

$$N(CH_3)_2C_6H_4-CO-C_6H_4(CH_3)_2N.$$

The formation of this product takes place in two phases, but I need not enter into that now.

The first experiments to turn Michler's synthetically prepared tetramethylated diamidobenzophenone to practical account were made by Dr. A. Kern, in the works of Bindschedler, at Basle. Dr. Kern proved that an agent like phosgene might be produced on a larger scale, and he invented a process to convert Michler's ketone base into methyl purple. This process was derived from the ketone synthesis of triphenylmethane from benzhydrol and benzene, and consisted in preparing the tetramethyldiamidobenzhydrol, and condensing the latter with dimethylaniline; thus the leuco base of hexamethylrosaniline was obtained, and then oxidised with lead peroxide. This process, which was too costly for practical purposes, has been superseded by one discovered by Dr. Caro, who has found that this ketone base can be made to form condensation products with dimethylaniline and other products directly, by the use of phosphorous trichloride—this substance converting it first into a chloride, which then reacts on the dimethylaniline, thus—

$$N(CH_3)_2C_6H_4-CCl_2-C_6H_4(CH_3)_2N+N(CH_3)_2C_6H_5=$$



$$\left.\begin{array}{l}N(CH_3)_2C_6H_4\\ N(CH_3)_2C_6H_4\end{array}\right\rangle C\left\langle C_6H_4(CH_3)_2N,Cl\right. \quad +HCl$$

And this reaction takes place quantitatively, the body being so pure that it readily crystallises from water in prisms, like potassium permanganate, only with a very much more brilliant lustre. These contain water of crystallisation. The condensation can also be effected with phosgene gas. The colouring matter obtained by this means is bluer than that obtained from dimethylaniline by oxidation, which consists chiefly of the pentamethyl compound.*

Diethylene can also be made into a ketone with phosgene or carbon oxychloride, and this product condensed with diethylaniline yields hexaethylpararosaniline.

Instead of dimethylaniline, dimethyl-α-naphthylamine can be used, and in this case a beautiful blue colouring matter is obtained, and if α-phenylnaphthylamine be employed, the *Victoria blue* is produced, and by varying the reaction in this kind of way a great variety of colouring matter can be synthetically prepared.

With ammonias this ketone condenses to form the new yellow colouring matter, *auramine*, with aniline *phenylauramine*. With quinoline it produces a green very similar to Victoria or benzaldehyde green. I must not however spend any more time over this interesting part of the subject, but may say here again we have pure scientific research conducted for its own sake, bearing fruit. The discovery of W. Michler, which remained for seven years a matter of theoretical interest, now comes forward as a matter of practical value.

Anthraquinone Series.

I must now draw your attention to the important class of colouring matter compounds obtained from anthracene or anthraquinone.

Alizarin and the other colouring matters related to it form one of the most important branches of the coal-tar colour industry, and is one of special interest, because alizarin was the first instance of the production of a natural colouring matter artificially. It will be quite unnecessary for me here to say much about the madder root, which was the original source of alizarin, and was grown in such enormous quantities, but now is nearly a thing of the past; nor will I enter into the early chemical history of alizarin, and all the laborious work which was bestowed upon it by Dr. Schunck and others. As you are probably all aware, the relationship of alizarin and its formation from the coal-tar hydrocarbon anthracene was the result of the labours of Graebe and Liebermann, the researches which culminated in this being of a purely scientific nature. The original process for obtaining it has, however, not been found of practical value, but a new one in which sulphuric acid could be used in place of bromine was afterwards discovered by Caro, Graebe and Liebermann in Germany, and by myself in this country, apparently simultaneously. A second process was also discovered by me which was worked nearly all the time I was engaged in this industry. In this dichloranthracene was used instead of anthraquinone, and the product thus obtained yielded colours of a brilliancy which it has been found, even to the present time, difficult to match by the anthraquinone process.

At the time of the discovery of artificial alizarin, anthracene was not prepared by the tar distillers, as it had no application, and very little was known about it. It was discovered in 1832 by Dumas and Laurent. In 1854-55, when studying under Dr.

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* See Patents, Caro, 4428, September, 1883; 4850, March 13, 1884; and 5038, March 18, 1884.

Hofmann, I worked with it for some time, but my results were never published, because, owing to the erroneous formula given for it by Dumas and Laurent, which was accepted, my results would not fit in; nevertheless the information obtained afterwards proved of great value to me, although at the time the labour spent appeared to be lost labour, showing the value of research even when not successful. The formula of this hydrocarbon was not established until 1862, when it was studied by Dr. Anderson. This was only six years before the discovery of Graebe and Liebermann, and, had not the formula of anthracene been established before these chemists commenced their work, the relationship of alizarin to it would not have been discovered, and up to this day it is possible that this artificial alizarin industry would not have been in existence. Researches like that of Dr. Anderson I have often heard spoken of slightingly, because they don't bear much on their surface; but who knows what such work may lead to? Earnest workers cannot be too much encouraged.

As anthracene was not a commercial product, it was necessary to experiment on its production before alizarin could be manufactured, and not only on the best methods of getting it, but also to get a rough idea of how much could be produced, because unless the hydrocarbon could be obtained in large quantities, artificial alizarin could not compete with madder. In our works at Greenford Green we commenced by distilling pitch; but afterwards tar distillers were induced to try to separate it from the last runnings of their stills by cooling and then filtering off the crystalline products which separated out, and in fact visits were paid to most of the tar distillers of the United Kingdom, others being corresponded with on the subject, and the result was that in a short time such quantities came in that the distillation of pitch was abandoned. And although much doubt and anxiety prevailed at first as to the possibility of getting a sufficient supply of this raw material two or three years since, there were about 1000 tons of commercial anthracene (about 30 per cent.) produced in excess of the requirements, the annual production in the United Kingdom being estimated at about 6000 tons 30 per cent., or nearly 2000 tons pure anthracene.

Although the colouring matter obtained from anthraquinone or dichloranthracene was at first simply considered as alizarin more or less pure, yet on investigating the matter it was soon found that it contained other colouring matter. To this I drew attention in 1870 (*J. Chem. Soc.* xxiii. 143, footnote), and in 1872 gave the analysis of a product which I named anthrapurpurin, followed by a more extended account a year afterwards (*J. Chem. Soc.* xxv. 659, and xxvi. 425). This was called anthrapurpurin; because it is an anthracene derivative having the formula of purpurin, with which it is isomeric. In the latter paper I also referred to another colouring matter dyeing alumina mordants of an orange colour (*J. Chem. Soc.* xxvi. 425). It was also shown that anthraflluoric acid when fused with alkali gave a colouring matter behaving with mordants in the same way (*J. Chem. Soc.* xxvi. 20), and this has proved to be the same body. This latter reaction was afterwards more fully studied by Schunck and Roemer, and the colouring matter produced by it was shown also to have the formula of purpurin; they therefore called it flavopurpurin (*Ber.* ix. 678), so that the colouring matters formed have proved to be three in number—alizarin, anthrapurpurin, and flavopurpurin, all of which are valuable dyes, whereas in madder root there is only alizarin and purpurin, the latter being of but secondary value. This can now also be produced from anthracene. The researches which have been made on the subject of the conditions under which these different colouring matters are formed, have led to the discovery of methods for their separate production, so that in artificial alizarin, which name commercially embraces all these colouring matters, both mixed and separate, we have more than a simple replacer of madder root, and as these colouring matters just referred to can be applied with the same mordants, varieties of styles of work can be produced by the calico printer and dyer which before were unknown. Anthrapurpurin is, I believe, of as great importance as alizarin itself, and used with it increases its brilliancy, and alone gives very brilliant scarlet shades.

Artificial alizarin was first produced commercially in this country by my firm at Greenford Green in 1869, when 1 ton was produced; in 1870, 40 tons were made, in 1871, 220 tons, and so on increasingly. It was not produced on the Continent until 1871, when, according to Graebe and Liebermann, 125-150 tons were made. These weights do not apply to dry colour, but to paste.

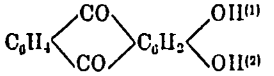
I cannot go into any lengthened account of the chemistry of this industry here; its development, however, has kept pace with theoretical investigations, in some cases it may be said to have forestalled it. For example, in the old methods of working, more anthrapurpurin than alizarin was produced; the conditions required to modify this were found out by experiment. According to all our previous knowledge as to the introduction of hydroxyl into a body by the fusion of its sulphonic acid with alkali, a monosulphonic acid should give a monohydroxyl compound, and a disulphonic acid a dihydroxyl compound. Therefore to produce alizarin, which is a dihydroxyl compound, an anthraquinone disulphonic acid was thought to be the proper thing to use. By experience this was gradually found to be incorrect, a monosulphonic acid being required to produce alizarin, a disulphonic giving anthra or flavopurpurin, the colouring matter not being due to the primary but to a secondary reaction, as was afterwards shown by research—the mono and dioxyanthraquinones (the latter known as anthraflavic and isoanthraflavic acids) being the first products of the reaction, and then undergoing oxidation by the caustic alkali employed, yielding the corresponding colouring matter, a portion of the products, however, being at the same time reduced back to anthraquinone.

A very important improvement preventing this loss by reduction was discovered by J. J. Koch, who found it might be avoided by the use of a small quantity of potassium chlorate with the alkali used in the fusion.

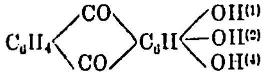
The amount of caustic soda used in this industry is very large, and at the Badische Anilin- und Soda-Fabrik,—and, I believe, elsewhere—it is made on the spot; and I must say the cleanly way in which alkali is made in the above works contrasts very favourably with what I have seen in some of the alkali works in this country.

Like rosaniline, alizarin has now become a material for preparing other colouring matters. Of these there are two in use—viz., nitroalizarin, which gives orange-yellow shades with alumina mordants, and alizarin blue, a remarkable compound prepared from nitroalizarin by treating it with sulphuric acid and glycerol. This gives shades of colour like indigo. When first discovered, considerable difficulty was found in its application on account of its insolubility; it has since been found to form a soluble compound with sodium bisulphite, and by this means its application has become much easier. The constitution of the colouring matter derived from anthracene may be represented as follows :—

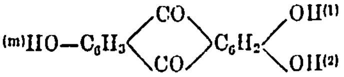
Alizarin



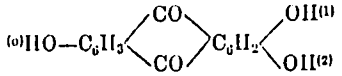
Purpurin.



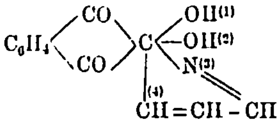
Anthrapurpurin.



Flavopurpurin.



Alizarin Blue.



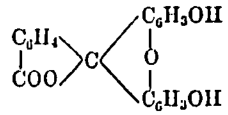
Those colouring matters under the name of artificial alizarin are the most important of the coal-tar colours, their money value amounting to more than a third of the entire value of all the colours produced in this industry, and at present the price of artificial alizarin compared tinctorially is not more than one-fourth of that which madder or garancine ordinarily were before their production. There are now three works producing it in this country, but the bulk of that used still comes from Germany.

Phthalines.

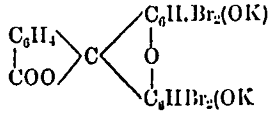
The discovery of this class of bodies dates back to 1871, and was the result of the investigation of Baeyer. He found that phenols unite with a number of polybasic acids and with aldehydes, with separation of water when the mixture is heated alone, or with glycerol and sulphuric acid, the compounds formed not being ethers. Those produced when phthalic anhydride is employed, and which embrace those of practical value, are called phthalines. The first of these discovered by Baeyer was *galleïn* (*Ber.* iv. 457), produced by heating pyrogallol with phthalic anhydride ; its formula is $C_{20}H_{14}O_5$; by reduction it loses the elements of water and combines with hydrogen forming *cœruleïn.* These colouring matters, which for a long time remained unnoticed, are now being extensively used.

Later, in 1871, Baeyer discovered *resophthalin,* or *fluorescein* (*Ber.* iv. 555). This substance, which is remarkable for its yellowish green fluorescence, dyes silk and wool yellow, but does not combine with mordants, and is not a very useful dyeing agent. But it was discovered by Caro in 1874, the subject being afterwards worked out jointly with Baeyer, that fluorescein when brominated yielded that beautiful dyestuff now called *eosine* ; this was introduced into the market in July, 1874. Other substitution products were then studied, and the iodine product was found to give bluer shades of red than the bromine. One of the most beautiful colours of this series is the dichlortetraiodofluorescein, in the preparation of which dichlorphthalic anhydride is used. It is called *phloxine.* The methylic ether of eosine and its nitro derivative also have become commercial articles. These bodies are now manufactured in a practically pure condition. Their structure has been made out by research to be as follows :—

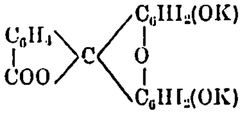
Fluorescein



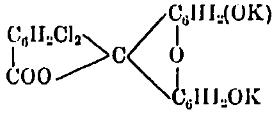
Eosine. Tetrabromofluorescein (Potassium Salt).



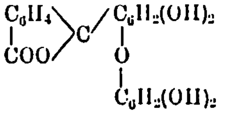
Tetraiodofluorescein (Potassium Salt).



Phloxine. Dichlortetraiodofluorescein (Potassium Salt).



Galleïn



The introduction of these colouring matters had a great influence on the manufacture of phthalic acid. This acid, it will be remembered, was proposed a good many years since as a source for the production of benzoic acid, which was largely in demand for the manufacture of aniline blues, phthalic acid when carefully treated with lime yielding calcium benzoic. But as phthalic acid was required to be produced in an extensive way, new experiments had to be made on the subject. The difficulties connected with this were surmounted by the Badische Anilin- und Soda-Fabrik, who are now the chief manufacturers of this body and its anhydride, which is the substance required ; when freshly prepared it is one of the most beautiful products one can see.

Dichlorophthalic acid is now also manufactured for the preparation of the bluish shades of fluorescein derivatives already referred to. But this is not all ; it was not only necessary to produce this anhydride in quantity, but it was necessary also to produce *resorcinol.* This substance was originally prepared from galbanum by fusing it with potash, or by distilling brazilin, etc., both technically impractical processes. It was afterwards produced by fusing various halogen derivatives of phenol and benzene sulphonic acid with alkali ; these also were not practical processes. It was, however, eventually found that it could be produced by fusing metabenzenedisulphonic acid with potash, the original observation being made by Gallik ; and by this process this product, which was a rare compound, is now manufactured and has become a common one, being produced in very large quantities.

Indigo Series.

Indigo is too well known a substance for me to make any remarks in reference to its history as a colouring matter, and with reference to the chemical side of the question I suppose few substances have had more work bestowed upon them than this body, so that I must confine any few remarks to its artificial formation. There is one point of interest, however, connected with indigo, and that is that it was the original source of aniline, this base being discovered in the products of its destructive distillation by Unverdorben, in 1826, as already mentioned.

Notwithstanding the large amount of work which has been bestowed upon this colouring matter, its constitution has only been lately arrived at, and for this, and the methods of its artificial formation, we are indebted to the beautiful and laborious researches of Baeyer. The first process for its artificial production was patented by Baeyer in March, 1880. The process consists in preparing orthonitropropiolic acid and acting upon it in presence of an alkali, with a reducing agent, such as grape sugar, xanthate of sodium, etc.

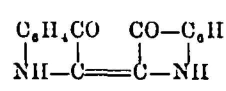
$$2[C_9H_5(NO_2)O_2]+H_4=2CO_2+C_{16}H_{10}N_2O_2+2H_2O.$$

This process renders the application of artificial alizarin very easy to calico printing, because the products can be applied to the fabric and the reaction then completed, and thus the indigo is formed and fixed in the fibre, and this process is in use in some of the printworks of Mulhouse, where there is a continued though small demand for orthonitropropiolic acid. Other processes have been discovered by Baeyer for the formation of indigo; he has found that it can easily be formed from orthonitrobenzaldehyde by condensation with bodies containing CH_3CO group, such as acetone.

Hitherto this artificial formation of indigo has not met with much practical success. This does not arise from difficulties in its manufacture, but in its cost compared with natural indigo, which is a very cheap dyestuff.

So far as it has been manufactured, however, the possibility of this has been entirely dependent upon scientific research disconnected with its study. To prepare nitropropiolic acid it is necessary to begin with cinnamic acid as a raw material. This acid, until 1877, was only obtained from certain balsams, and was a very costly material. It was then discovered that it could be produced with comparative ease by the action of acetic anhydride and an acetate on benzaldehyde (*Journ. Chem. Soc.* xxxi. 428). Caro afterwards found that this process might be simplified by heating a mixture of benzylidene dichloride with sodium acetate, and it is by this process that it is now prepared.

The constitution of indigo Baeyer represents as follows :—



$$\begin{array}{lcl} C_6H_4\,CO & & CO-C_6H_4 \\ \;|\qquad\;\; | & & \;|\qquad\;\; | \\ NH-C & = & C-NH \end{array}$$

Several derivatives have been made which are interesting dyes, such as methyl indigo, tetrachlor indigo, etc.

Azo Compounds.

The commencement of the history of the azo colours in an industrial sense has little to do with the theoretical side of the question, the early products being the offspring of empirical observations, and in no way connected with the theory of the diazo compounds, a condition of things very different from that now existing. Time will not allow me to enter into the beautiful work of Griess, much of which will be found in the "Philosophical Transactions" for 1864.

The first definite compound of this class, shown to possess dyeing powers, was a substance discovered by Prof. Church and myself, known first as nitrosonaphthalene, then as azodinaphthyldiamine, but now called amidoazonaphthalene. This substance, however, was of no practical value, because its salts, which are violet, cannot exist except in the presence of a certain amount of free acid. This substance has since been found of value in the preparation of the Magdala Red.

The first substance of this class sent into the market was the phenylic analogue of amidoazonaphthalene—viz., amidoazobenzene, which was discovered by Mène. It was introduced by Nicholson, who prepared it by a process which has not been published. It was afterwards patented by Dale and Caro, in 1863. This is a yellow dye, but did not demand success, because of its volatility. It has, however, since become useful for the manufacture of induline.

The first really successful azo colour was Manchester or Bismarck brown (triamidoazobenzene), which is produced by the action of nitrous acid on metadiamidobenzene.

The next important step took place in 1876, by the discovery of chrysoidine, by Caro and Witt. Independently, this product is prepared by the action of diazobenzene on metadiamidobenzene.

About this time the subject began to be worked out on a scientific basis, and since then the number of diazo dyes produced is marvellous, and it will be useless for me to do more than to refer to one or two of the most important. About this period also the value of the sulpho group began to be realised, and this has greatly added to the value of these dyes.

The first use of the sulpho group in relation to azo colours was in connection with amidoazonaphthalene, patented by myself in 1863.

During the early history of the coal-tar colours, innumerable experiments were made with naphthalene derivatives to produce colouring matters, but no results of any value were obtained; the experiments were mostly made with naphthylamine. The first colouring matter that was obtained from it that was of value was Martius' yellow a dinitronaphthol. After this came the Magdala red, which was not much used. The principal development of the coal-tar colours of late years has, however, been in connection with diazo reaction. In these reactions naphthol is much used, and this product, which a few years ago was unknown, is now manufactured by tons by fusing naphthalene sulphonic acid with alkali, and is produced at a few pence per pound. Most of the azo colours produced from benzene derivatives are of a yellow or brown colour, but, by taken products of a higher molecular weight, colours of different shades of red are produced. The one which has commanded the greatest success is the scarlet, first known as Meister's scarlet, produced by the action of diazoxylene chloride on the disulphonic acid of β-naphthol; its constitution may be represented thus :—

$$C_6H_3(CH_3)_2-N_2-C_{10}H_4(OH)(HSO_3)_2.$$

And in the formation of bluer shades, diazocumene chloride is used. The cumidine used is now made from xylidene, by the beautiful reaction of *Hofmann's*, in which an alcohol radical associated with the nitrogen leaves that element, and enters into the hydrocarbon radical. These scarlets have had a very injurious influence on the cochineal market, and have in many cases displaced cochineal.

If α-diazonaphthalene chloride be used instead of the xylene or cumene compounds, the colours known as Bordeaux is produced. Then, again, where derivatives of α-naphthol are used, different results are also obtained, so that great varieties of products can be produced. The preparation of these azo colours is a matter of much simplicity, the colouring matter being precipitated in bringing the products together, and, moreover, they can be produced in almost theoretical quantities; hence they are remarkably cheap dyeing agents. The following are the formulæ of some of these azo dyes :—

Bismarck Brown. $NH_2C_6H_4.\overset{(m)}{N_2}.C_6H_3(NH_2)_2HCl$.

Chrysoidine. $C_6H_5.N_2.C_6\overset{(m)}{H_3}(NH_2)_2HCl$.

Fast Yellow. $KSO_3.C_6H_4.N_2.C_6H_4NH_2$.

Manchester Yellow. $\overset{(3)}{NaSO_3}.C_6\overset{(1)}{H_4}.N_2.C_6H_4NHC_6H_5$.

Orange. $\overset{(4)}{NaSO_3}.C_6H_4.\overset{(1)}{N_2}.C_{10}H_6\overset{\beta}{(OH)}$.

Fast Red. $NaSO_3.C_{10}H_6.N_2.C_{10}H_6\overset{\beta}{(OH)}$.

Ponceau G. $C_6H_5.N_2.C_{10}H_4OH\overset{\beta}{(NaSO_3)_2}$.

Ponceau 2R. $(CH_3)_2C_6H_5.N_2.C_{10}H_4OH\overset{\beta}{(NaSO_3)_2}$

Bordeau. $C_{10}H_7.\overset{\alpha}{N_2}.C_{10}H_4OH\overset{\beta}{(NaSO_3)_2}$.

From which it will be seen that the colour changes from yellow to red and claret by the increase of the molecular weight of the radicals introduced, and also by the relative position occupied by the groups, etc.

Quinoline Compounds.

Products of the quinoline series have of late been claiming attention in relation to colouring matters. It will perhaps be remembered that, in the early days of the coal-tar colour industry, a beautiful blue colour belonging to this series, discovered by Greville Williams (*Chem. News*, Oct. 11, 1860, 219), was introduced. This substance was called cyanine. Its employment as a dye for silk at first produced quite a sensation, on account of the beauty of the colour; but unfortunately it was too fugitive to be of any practical value. Recent researches have shown that chrysaniline is also to be regarded as a body of the chinoline class. Alizarin blue, and also the beautiful yellow dye obtained from acetanilide by Fischer, and known as flavanilin, are found also to belong to this class of substances.

Other colouring matters which have since been prepared from quinoline direct might be referred to did time permit. The peculiar green which is produced by the condensation of tetramethyldiphenylketone with quinoline is of interest, because the introduction of this quinoline has a very different influence on the resulting colouring matter to that of groups containing amidogen—in fact, it appears to act more like phenyl, as the green is very analogous to benzaldehyde green.

There is a very interesting new manufacture growing out of the coal-tar colour industry, and that is, the preparation of derivatives of quinoline as substitutes for quinine. I have mentioned that much work has of late been directed to the study of quinine itself, and although the artificial formation of this substance has not yet been discovered, new bodies have been obtained during these investigations which are thought to possess valuable medical properties. This is rather a remarkable development from this industry, seeing that it was owing to experiments made on the artificial formation of quinine that it owes its foundation.

. There is another peculiar colouring matter I have not yet referred to—peculiar, as it contains sulphur. I refer to methylene blue, a very valuable dye, the constitution of which has been so well worked out by Bernthsen. I feel I must be content with this slight reference to it.

As I have shown, the coal-tar colour industry originated in this country, where for some time it was solely carried on. The second impulse was from France in the discovery of magenta and its blue and purple phenyl derivatives, which were soon brought to a state of great purity in this country. The Hofmann violets were then discovered and produced also in this country, several other colours being perfected and largely used. By this time the manufacture of coal-tar colouring matter had made some progress in Germany and Switzerland; crude products in a cheap form were first made, but improvements soon followed. The subject of these colouring matters was taken up with great earnestness in the German laboratories so much so that it was stated at one time that this industry was acting injuriously to science, as it had diverted an undue amount of attention from other subjects. Time has, however, proved the groundlessness of this statement. This laboratory work, as well as research work generally, fitted a number of highly-trained chemists to enter the colour works, where they soon improved the processes, and thus they were able to produce products of a quality to compete with those of English manufacture, which had, owing to their purity, given superior and more reliable shades of colour in the hands of the dyer; and the result of the application of this scientific labour to this industry is that Germany produces products of the highest class and at the lowest price. The fact that Germany is now the head-quarters of this industry, raises the important question, Why has England allowed this state of things to come about? All the raw materials are produced in this country, both the products from coal and the other chemicals required, and, as we have seen, the industry originated and was first carried on here, and, in addition, we are the greatest consumers of the colouring matters. This fact is well worth considering, and it is many-sided. In my opinion, the Patent Laws, and the difficulty of preventing infringements from abroad, was one cause which may have prevented this country from maintaining its first position.

When speaking of the early history of the first coal-tar colour mauveine, I referred to this class of infringement and how it was first met by the proceedings taken against the agents employed in this country, and that this course was so far successful, but only pointed out how easily the law could be evaded if foreign manufacturers gave up responsible agents and sold direct to the consumers. Having no duties on such articles, no assistance could be obtained at the Customs, and the colouring matters were generally declared under the name of vegetable dyes or extracts, so that it was impossible to stop them entering the country, and even when found, owing to the onus of proof of their being manufactured by the patentee's process laying with the patentee, an almost insurmountable difficulty was raised, as in most cases no traces of the products used in the preparation were left in the colouring matter. The only other proceedings which could be instituted were against the consumer; here again the difficulties were practically insuperable.

In most cases the consumers were using the patentee's products to some extent, and it was impossible to know to what extent, in fact, without going into the many details connected with this point, it may be assumed that in most cases proceeding against a consumer of this kind of article is detrimental and practically useless.

The result of this infringment, by importation from abroad, is that a patentee had to compete against all other manufacturers with the exception of *his own countrymen*.

There can be but little doubt that this state of things has had much to do with preventing the development of this industry, and crippling enterprise in this country, as it prevented manufacturers even from working under royalties, there being no security whatever except in name. Again, the fact that a foreigner could take a patent in this country, manufacture in his own country, and send the product here, was a great source of loss and mischief to our trade. The new patent laws may probably alter this, but still the difficulty of importation in defiance of patent rights still remains.

There is another matter which tells much against this country—namely, that we are not able to export colour to foreign countries upon the same conditions as foreign manufacturers can into this, because we are met with import duties which handicap us to a prohibitive extent, whereas the foreign manufacturer, being protected in his own country, may maintain his prices there and sell at a lower price in this country; but what is still more injurious, he may dispose of surplus production in this country at or even below cost price. The injurious effect of such a course upon our market can be easily understood by business men, and I need not go into it here. These are matters our manufacturers have to contend with, and cannot help themselves; there is, however, one matter in which they are undoubtedly at fault.

We find that in Germany the manufacturer understands the value of well-trained chemists, and sympathises with them; they also realise the value of theoretical chemistry—this is a condition of things we don't find in this country.

Unless I am mistaken, the coal-tar colour industry has acted as the great stimulus to the development of general chemical industries of Germany, and these, by starting with so much scientific aid as they have called to their assistance, have made an amount of progress during the last 25 years which is most remarkable. Up to that time England had been the seat of most of the large chemical industries, and the success which we have had appears to me to have produced a feeling of false security, and more attention has been paid by the heads of firms to the markets than to the chemistry of their manufactures.

I believe that 30 years ago there were very few chemists employed in chemical works, either in this country or on the Continent. Now there are very few without them; but in this country they are far less numerous and much less efficient than in Germany, and for this our manufacturers are to a great extent responsible. I am told that at some of our large chemical centres, the chemists, or so-called chemists, are sometimes paid not more than could be earned by a bricklayer. If such openings are put by manufacturers before young men, their parents are not likely to give them an expensive scientific training. If they get any they are not likely to continue it longer than enough to do analysis very imperfectly, say by studying for about nine months. An ordinary tradesman would not be considered efficient unless he passed a much larger apprenticeship than this, but I know teachers complain that it is difficult to get students who are to be works chemists to stay longer than this. The result is that when really efficient men are wanted, they are not to be found, and they have to be got from abroad. In my address to the Chemical Society last year, I referred to the past neglect of research at our chemical schools, so that I need not speak further on that aspect of the subject here, though it is an important one in relation to our industries.

There is no chasm, as we have already seen, between pure and applied chemistry, they do not even stand side by side, but are linked together, so that a technical chemist needs to be a thorough chemist, and unless we employ such men we must be at a great disadvantage in relation to foreign manufacturers.

This brings me to a subject which has occupied much attention of late, but I fear is much misunderstood by the public generally. I refer to the teaching required by technical men, or technical education. The general idea is that it should be carried out in what may be called its narrow sense. That is to say, that it should be in relation to the existing manufactures and the present methods employed in them. Whereas there can be no doubt it will be of small service unless it is carried out on a very broad and scientific basis. As it is, the processes which are *publicly* known and taught, are more or less antiquated, simply because improvements are naturally kept secret as long as possible, and therefore to spend a large amount of time in studying details of old processes would manifestly be a great waste of power, and I am glad to find that this view of the matter is held by some of our leading chemical manufacturers. Our chemical industries are now undergoing such rapid and radical changes, owing to the advances in scientific discovery, that this cannot be too much borne in mind. To train a young man as a technical chemist, I consider, requires first that he should have a thorough knowledge of chemical science and know how to use it by conducting research, that he should have a general knowledge of those sciences which are connected with it, such as physics, and of those subjects required by all manufacturers, such as engineering mechanics, etc., and also study the way chemical operations are carried out on the large scale, not in one branch of manufacture only, but in many.

With men in our works so trained, and of course possessing the suitable natural qualifications, we might expect to see our chemical industries make good progress and keep well to the front, but such a course of study could not be gone through in twelve months, nor would men so qualified be content to receive the remuneration for their services which is now given.

The proposed course for technical chemists at the Central Institute of the City and Guilds of London Institute is to occupy three years; the students having already devoted one year to elementary chemistry, this makes four years of study, and this is hardly sufficient. It is to be hoped that those who are to be principals, or to take responsible positions in works, will avail themselves of the opportunities afforded by this Institute or get some similar course elsewhere, so that we may have efficient men in this country to advance our chemical industries, and also that the value of such chemists may be appreciated in this country.

The employment of well-trained chemists in Germany, and the division of labour which results from this, has no doubt been one of the chief causes of the great success not only in the colour, but in other chemical industries. In this country it not unfrequently happens that an inventor, or the head of a firm, feels that no one can do the work he is connected with like himself, which is probably quite true, but at the same time he forgets that one person is not able to attend to the details of a number of processes adequately from sheer want of time and strength; if, however, properly qualified men can be set over them, although they may be slower and less capable than himself, yet having less divided minds and more time they are able to work out the details under his direction with much more success than he could alone, as well as see things from other points of view, and thus greater perfection will be attained. I think this is a matter deserving of careful attention on the part of our manufacturers.

I have now given a very brief, and therefore a very imperfect outline of the history of the coal-tar colour industry, an industry to which none other can be compared for its rapid progress. I have drawn your attention to the fact that it is the offspring of scientific research, that in return, as I before stated, it has in many cases given a fresh impulse to research by giving the chemist new products, and also by opening up new subjects of theoretical interest for consideration, and from the fruits thus resulting again reaping further benefit. This linking together of industrial and theoretical chemistry has undoubtedly been the great cause of its wonderful development. We now have not only all the colours of the rainbow, but we have also the more sombre, but often not less useful, colours, and, moreover, there are also great varieties of products of similar colour possessing different properties which fit them for special uses. This industry is also one of no mean dimensions. I have not been able to get any very recent statistical information on this subject, but notwithstanding the great reduction of prices of the products of late years, yet owing to the extended development it has undergone, the value of the annual output has probably increased and not declined, and from what information I have on the subject I should say it is perhaps not less than £3,500,000.

In my remarks I have also been led to refer to some of the points connected with the migration of this industry from this country to Germany, and the probable influence our patent laws had upon this, to the matter of technical education, and the employment of high-class chemists in chemical works. This latter subject is undoubtedly of great importance, and requires the earnest consideration of our manufacturers. If it is found profitable to employ chemists of this class on the Continent, surely it should be found equally profitable to employ them here. In conclusion, I am happy to say there are signs of the coal-tar colour industry returning to our country, in part at any rate, especially in relation to alizarin, for which there are now three large works in existence, and the production of other colouring matters is also increasing.

Mr. J. C. Stevenson, M.P., in proposing a vote of thanks, said that they were fortunate in having a president who had all along been identified with the very important industry, the progress of which had just been described. Having himself given his attention to the more simple department of inorganic chemistry, he admitted his incompetence to fully appreciate, much less criticise, the amount of research thus laid bare, but at any rate he could admire the facility with which the president manipulated the complex formulæ of the substances described. Nothing could more clearly illustrate, on the one hand, chemical science in its marvellous interconnection with chemical industry and, on the other hand, the important position which in the future these new industries must take in their Society. Coal tar, once adjudged little better than a refuse and only fit for daubing palings, now appeared as the source of a host of beautiful colours—colours so bright as to shock that modern æstheticism which demanded to be clothed in the hues of faded leaves. But even these were doubtless well within the powers of their president to produce. At Avignon there was a monument to the man who benefited his countrymen by the introduction of the madder root as a staple industry in the Department. What a memento was this monument of a vanished industry displaced by the process which the President had described. At the same time, they must remember that chemistry was not as yet independent of organic materials for these colours—the product of the vegetable life of the primeval forests. Whether chemistry would ever make coke and water into sugar was problematical, but at all events, up to the present, it had only succeeded in extracting and developing from organic bodies principles already existent in those bodies. He was glad to note that these modern chemical industries were still in some sort dependent on their older brethren for reagents, and that they still required caustic soda and hydrochloric acid. On these older industries the remarks of the president had a bearing, though in them there might not be so much scope for science as there was in the special branch chosen by the president; nevertheless, he was free to confess that in the past too much reliance had been placed on our natural advantages of cheap fuel and machinery, and too little upon science. Manufactories might be more orderly, and the British workman had yet to learn the value of tidiness. He moved that a hearty vote of thanks be given to the President for his most able address.

Mr. E. K. Muspratt, in seconding the motion, was glad to hear Dr. Perkin state that the removal of the aniline industries to Germany was due, in his opinion, to two causes—(1) The effect of our patent law, and (2) the want of technical education in this country. He himself mainly ascribed it to the second cause, but in a somewhat wider sense; and so far as patents were concerned, the evils arose not from any defect in the law of patents, but from the absence of a uniform and international patent law. Technical schools were of undoubted value, but if children were not well educated in primary and intermediate schools they would never grow up to be successful competitors with the Germans. Long before technical schools were established the German universities afforded scientific education in abundance, and one of the reasons why they had been so successful in applying science to their industries was that many of them were educated as purely scientific chemists. We ought not to lose sight of this fact, but should train our rising generation to think and investigate for themselves, thus becoming efficient chemists rather than mere testing machines.

Mr. Walter Weldon, F.R.S., asked Mr. Stevenson to somewhat enlarge the scope of his motion so as to convey to Dr. Perkin a vote of thanks not only for his address but also for his great services as President. During the past session some ten or twelve council meetings and twenty or thirty committee meetings had been held, and Dr. Perkin had attended all those meetings, and had given the most careful attention to every item of business which had come before them. In fact he had torn himself away from his beloved research to attend to the business of the Society as devotedly as a merchant in the City attends to the business by which he gains his livelihood.

Mr. Stevenson then put the motion in the amended form, which was carried unanimously.

The President then briefly replied.

The scrutineers then presented their report on the results of the voting for ordinary members of Council, as follows:—

The scrutineers reported that they examined 205 ballot lists, of which five were invalid. The result of their examination of the valid votes given shows that the following have been elected ordinary members of Council:—

R. Forbes Carpenter.
Henry Doulton.
Dr. John Evans, F.R.S.
Ivan Levinstein.
Dr. R. Messel.
B. E. R. Newlands.
Thos. Royle.
Dr. S. A. Sadler.
Sir Bernhardt Samuelson, Bart., M.P.
Sir Charles Tennant, Bart., M.P.
Prof. W. A. Tilden, F.R.S.
John Williams.

(Signed) J. ROBBINS.
GEO. WARD.

The President declared the above duly elected, together with the following:—

President: Mr. E. K. Muspratt.

Vice-Presidents:

Sir F. A. Abel, C.B., D.C.L., F.R.S.
Sir J. Lowthian Bell, Bart., F.R.S.
Alexander M. Chance.
Prof. James Dewar, F.R.S.
James Duncan.
David Gamble.
Dr. Peter Griess, F.R.S.
Dr. W. H. Perkin, F.R.S.
John Spiller.
E. C. C. Stanford.
J. C. Stevenson, M.P.
Walter Weldon, F.R.S.

Treasurer: E. Rider Cook.

Foreign Secretary: Ludwig Mond.

Mr. David Howard proposed the reappointment of Messrs. Theobold Brothers as auditors, saying the complexity of the accounts was so great that it was desirable that professional auditors should be appointed.

Mr. William Crowder seconded the motion, which was carried unanimously.

NEXT PLACE OF MEETING.

Mr. Muspratt proposed that the next Annual Meeting be held at Liverpool, which he might describe, with Widnes, as being the birthplace of the Society. On behalf of the Section, he could assure the members that they would have a cordial welcome.

Dr. Hewitt seconded the motion, which was carried unanimously.

Mr. Muspratt then took the chair.

Mr. F. Siemens' paper was then read.

ON HEATING REGENERATIVE GAS FURNACES BY RADIATION FROM FLAME, AND ON PRODUCERS TO SUPPLY GAS SPECIALLY SUITABLE FOR THAT PURPOSE, AND FOR THE RECOVERY OF BYE-PRODUCTS.

BY MR. FREDERICK SIEMENS.

In tracing the action within a flame from the moment the gases unite until the heat has been fully abstracted from the products of combustion, the flame will be found to pass through various successive periods materially differing from one another; of these there are two which require quite different development and treatment. The first is the period of active combustion, the essentially chemical process by which the heat is produced. The second period is after combustion has been completed, when the products of combustion alone have to be dealt with, which still contain a great portion of the heat produced during the first period. The conditions of the flame during these two periods are so entirely different, that it is quite reasonable that they should be separately and differently treated, and should not be considered as one, as has been hitherto invariably the case. Whilst chemical action is proceeding, the flame ought to be allowed clear space within which to burn; it should not be interfered with by surfaces of any kind, and it should be allowed freely to emit its radiant heat; whereas the products of combustion having very little power of radiation, and not injuring surfaces upon which they impinge, should be brought into contact with the surfaces to be heated, for the purpose of abstracting their remaining heat.

As is well known, combustion is interrupted when flame meets solid surfaces, whilst the solid surfaces themselves also suffer—not so much from the heat as from the mechanical action of the flame; to explain these circumstances various theories have been proposed, as well as to account for the fact that flame has great power of radiation in its first stage and little in its second. It is agreed in all these theories that the gases in combustion forming the flame are intensely excited, and that the molecules of gas are rotating around one another, or are otherwise in violent agitation. According to the electrical theory, which is the one accepted by the author, a flame consists of small but innumerable lightning flashes, and it is at once evident that when a solid body is brought into such a flame it obstructs the action of the flame by arresting the motion of the particles of gas which strike on it, as well as by its attraction and adhesion; the molecules of the gas being resisted in their motion, combustion cannot continue, at least in those parts nearest to the opposing surfaces. As a result, smoke is produced, enveloping the obstructing surfaces; and radiation cannot act because of its inability to penetrate the cloud of smoke in which the flame is enveloped. Then, as regards the action of the flame on any surface, it is quite natural to expect that if flame is composed of innumerable flashes of lightning, no surface or body exposed to it can long withstand its action. The flame in its first stage being composed of innumerable lightning explosions, and carrying free carbon, accounts also for its radiant power. In the second stage of the flame, as no chemical action is going on, and there is no free carbon to emit heat by its incandescence, the carbon being converted into invisible CO_2, it is quite natural that there should be little radiant action.

A flame radiates much better than a solid body. The reason of this is that each particle of carbon raised to incandescence within the flame acts as a centre of radiation, and emits its light and heat in every direction, whilst a solid body simply radiates from its surface. Thus, in the flat-flame burner the edge radiates out nearly as much light as the face, and would radiate out quite as much, only that owing to its narrowness some of the incandescent carbon particles come in the way of the light radiating from those behind them; whilst the Argand burner serves as an illustration of a hollow flame, the light radiating outwards, not only from the outer surface, but from the inner surface through the flame itself, and heat and light obey the same law in this respect. If the area of a flame is doubled, it radiates four times as much as originally; whilst a solid body, if doubled in area, radiates only twice as much as before. A volume of flame applied for heating by radiation cannot therefore be made too large from an economical point of view, because the radiation from a body of flame increases, not according to its outer surface, but in proportion to its volume.

From a careful consideration of the various circumstances thus set forth, connected with the production and action of flame, the author has designed a furnace, now well known as the radiation furnace, a short description of which in some of its applications will be given later on.

In order to employ radiation in the most profitable manner, a gas, rich in hydrocarbons, should be used, for the production of which special forms of gas producers may be adopted with advantage. Of these there are two so far employed. One of these was described by the late Sir William Siemens in his paper, "On the Use of Coal-gas as a Fuel," read before this Society on the 29th June, 1881. A diagram (Fig. 1) of this producer is placed before the meeting, and it may be shortly described as consisting of a cylindrical chamber truncated towards the bottom, which is filled with coal through a large hopper at the top; this chamber is formed of an iron casing A, covered on the interior with a lining of refractory material B, and in this lining passages C are arranged all round for the exit of the gases. A large opening at the bottom admits of the withdrawal of ashes and clinkers that may be found in the combustion of the fuel, and a blast of air—which by preference should be heated—is directed into the very heart of the mass of fuel.

The result is a very high temperature in the centre of the mass, one of the essential conditions for the total conversion of coal into combustible gas being a maximum degree of heat at one portion of the process, and no heat is lost at that point, which loss would interfere with the due conversion of carbonic acid into carbonic oxide. At the same time, water, which is admitted by a continual streamlet near the bottom, is evaporated by the residual heat of the fire and clinkers which is thus utilised, and currents of steam are directed or drawn into the apparatus, passing through the zone of highest temperature towards the centre of the mass. They there become converted by contact with the incandescent fuel into carbonic oxide, and hydrogen (free from nitrogen), which add greatly to the calorific effect of the gas produced.

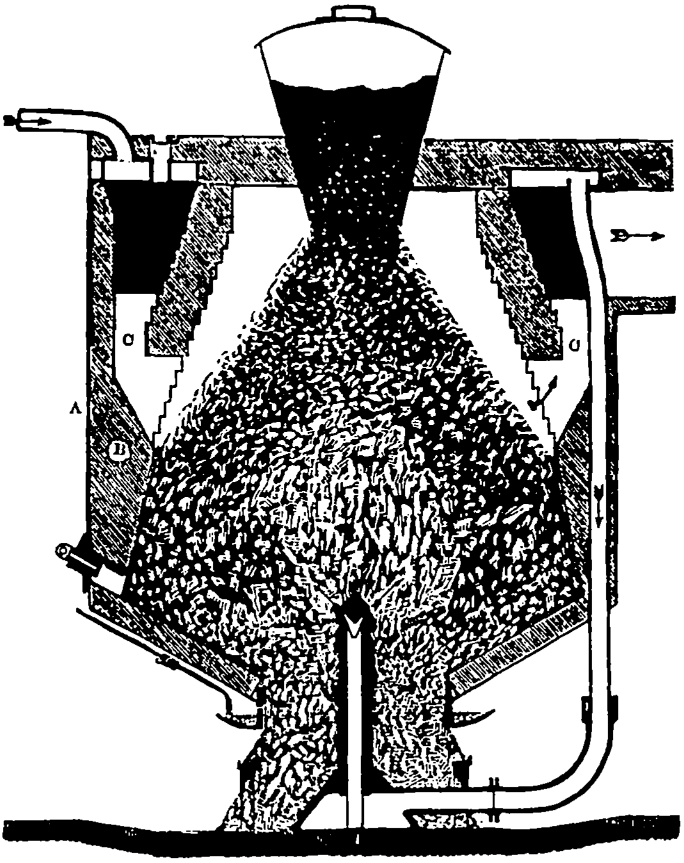


FIG. 1.

The modified form of Siemens' old-type producer, which is also employed for the purpose of enriching the gases by transforming the heavy hydrocarbons, that would otherwise form tar on condensation, is described in a paper read by the author's principal assistant, Mr. Head, before the Iron and Steel Institute, in May last, and published in the Journal of the Institute, Part I of the volume for 1885. The gas producer is divided into two compartments, one of which receives the hydrocarbons—the volatile constituents of the coal,—and the other the carbonic oxide formed by the decomposition of its solid carbonaceous matter. The proposed separation may be conveniently carried out by means of a curtain wall placed over the fuel, and by providing for the hydrocarbon constituents a separate outlet from the chamber thus formed.

Fig. 2 is a section of the modified gas producer arranged for this purpose, with the addition of the curtain wall A, which comes down to the level of the fuel at B, or may extend a little below it, dividing the gas producer into two compartments so as nearly to separate the zone B, where carbonic oxide is mostly produced, from the zone C, where hydrocarbons are

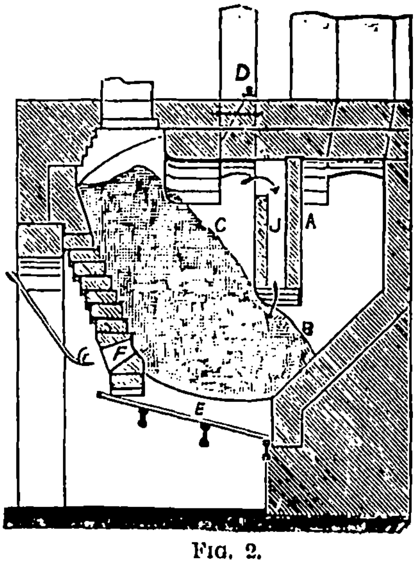


FIG. 2.

given off. At the bottom is a grating E open for removal of ash or clinkers, and for admission of air. When increased action is desired, air may also be admitted to the body of the fuel by one or more nozzles F, formed in the brickwork, the supply current to each being maintained by a steam injector G. The nozzle and injector are so situated and directed as to provide against blowing flame or gases down through the grating E.

The hydrocarbon gases which collect in the chamber C, are led away by channels J, which heat the hydrocarbon products from the zone C, and direct them on to the incandescent fuel in the zone B, whereby they are further heated and converted into permanent gases. The curtain wall A need not absolutely separate the chambers B and C from each other, for if a small proportion of the volatile gases should leak into the carbonic oxide compartment, as in doing so they would come into contact with incandescent fuel, the desired effect would thus be ensured.

That gases may be enriched by converting the hydrocarbons into permanent gases, was determined for the late Sir William Siemens in the following manner. A certain quantity of gas was collected in a graduated receiver from one of the Siemens old-type gas producers; this gas was taken immediately above the fire through one of the stoking holes, and was found, on cooling to atmospheric temperature, to be reduced in bulk from 120cc. to about 85cc., the apparatus being at the same time much coated with tar. The receiver having been cleansed with spirits of wine and washed with water, another sample of gas from the same producer was taken, with this difference, that on its way to the receiver it was passed through a combustion tube, which was heated by a spirit lamp. The same volume being collected as before, the weight of gas taken would be somewhat less than on the previous occasion, and had the gas on cooling to atmospheric temperature been reduced to the same bulk as previously without deposit of tar, the result would have been considered satisfactory; but a better result was obtained, for the loss in bulk was only about 20cc., the receiver being comparatively free from tar. It is to be regretted that time would not allow of analyses of the gas obtained under these conditions to be made, but gas made from Staffordshire coal, in the Siemens old-type gas producer, has been found to contain less than 35 per cent. of combustible elements when working at its best; whereas, gas made from the same coal in one of the Siemens modified gas producers, described above, where the desired conditions for conversion of tar into permanent gases are present, has been found to contain 48 per cent. of combustible elements.

At a works where the Siemens old-type and new-type gas producers were tested comparatively upon two open-hearth steel-melting furnaces, the result was a saving amounting to 28½ per cent. in weight of coal in favour of the latter, the same quality of coal being used in each case, and the furnaces being erected to the same plans, and doing the same work. Recently a block of four gas producers of the Siemens old-type have been altered by the addition of a curtain wall provided with channels J as above described, in which similar results have been obtained. By making the curtain wall A solid, instead of with channels J, as shown in the diagram, the two chambers B and C will be divided from each other so that the hydrocarbons liberated from the fuel may be led away by a pipe D for treatment for ammonia and tar, while the gases resulting from its complete decomposition will be led away separately to the furnace.

In some works it may be found convenient, after treatment of the hydrocarbon gases for tar and ammonia, to utilise some of them for illuminating purposes. Owing to the inferior description of fuel usually employed in gas producers, as compared with that used at gasworks, the illuminating power of the hydrocarbon gases may not be found equal to the standard of the gas supplied by gasworks; but larger or additional burners can be used, and by this means manufacturers may almost entirely save their gas bills. Taking each burner as consuming 7 cubic feet per hour, even a hundred such burners, lighted for twelve hours each day, would not consume all the hydrocarbons liberated from a ton of coal. Moreover, the quality of the illuminating gas could be improved by adding a little cannel coal to the fuel charged in the gas producers, or in some of them, during the time that the gas is required to be used for illuminating purposes, and this will afford an alternative method to the employment of larger burners, or a greater number of smaller ones.

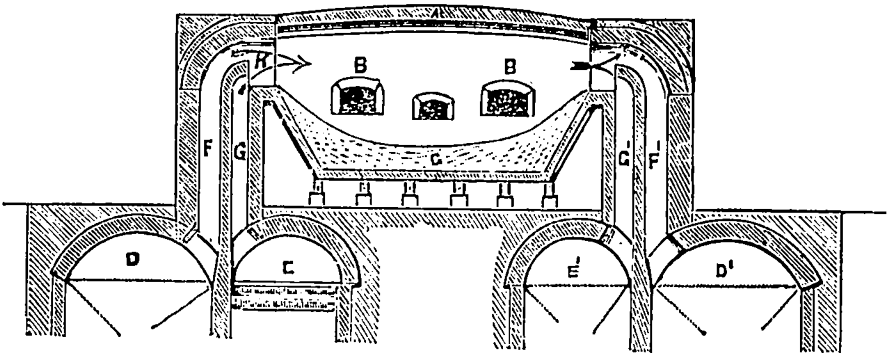


Fig. 3.

The gases not required for illuminating purposes should be returned to the main gas flue supplying the furnaces. Indeed, it is not desirable to use gases consisting mainly of carbonic oxide and nitrogen in regenerative gas furnaces, where the new method of heating by radiation is adopted, for which, as has been explained, gases rich in hydrocarbons are better.

In designing the regenerative gas furnace, in which radiant heat is to work to the best advantage, it is necessary that the gas and air ports shall open at some distance below the roof of the heating chamber, and at some distance also from the side walls, so that the inflowing gas and air may have unobstructed space after ignition for entering into combustion, and for the free development of the flame; for the same and other reasons the flame is kept as much as possible out of contact with the material on the furnace bed, and when these are crucibles, ingots, blooms, or packets of iron, they should be so placed that the radiant heat may play freely upon and about them.

The diagrams give sectional views of the furnace as now constructed for various purposes. A is the roof, B are the working doors, C the bed of the furnace upon which the materials are melted or heated, D and E are one of the pair of regenerators, and D^1 and E^1 the other pair, between which should be placed the pockets used for arresting the dust from the waste gases, as shown in Figs. 5 and 6. The gas and air are alternately brought into the heating chamber by the ports F, G and F^1, G^1, therein forming the flame which traverses it from end to end, as shown in Figs. 3 and 4, or sweeps round it in a semi-circular or horse-shoe form, as shown in Figs. 5 and 6. Where there are working doors, the flame should pass above their level; in this way the men will not be inconvenienced while watching operations inside the furnace; but, as already mentioned, the main object to be secured is to avoid contact of the flame with the materials under treatment, or with the walls of the furnace.

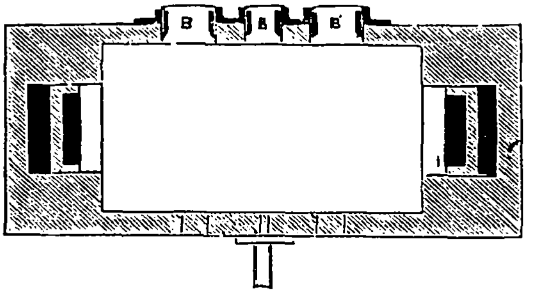


Fig. 4.

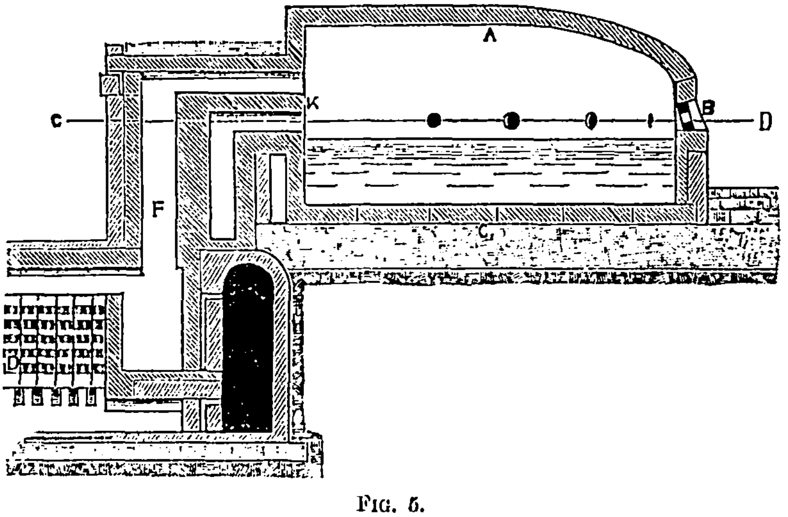


Fig. 5.

As shown in Figs. 3 and 4, which represent an open-hearth steel-melting furnace, the air inlet may be arranged above the gas inlet, thus forming two parallel horizontal ports for the delivery of the gas and air in broad streams into the furnace chamber, the inflowing air overlapping the gas. In cases where there is a great length of travel for the flame, such as represented in Figs. 5 and 6, the ignition is retarded by extending the horizontal wall, or tongue K, so that it shall only commence at the entrance of the gas and air into the furnace chamber, and the combustion may be extended throughout the furnace, the flame in this case taking a semi-circular or horse shoe course.

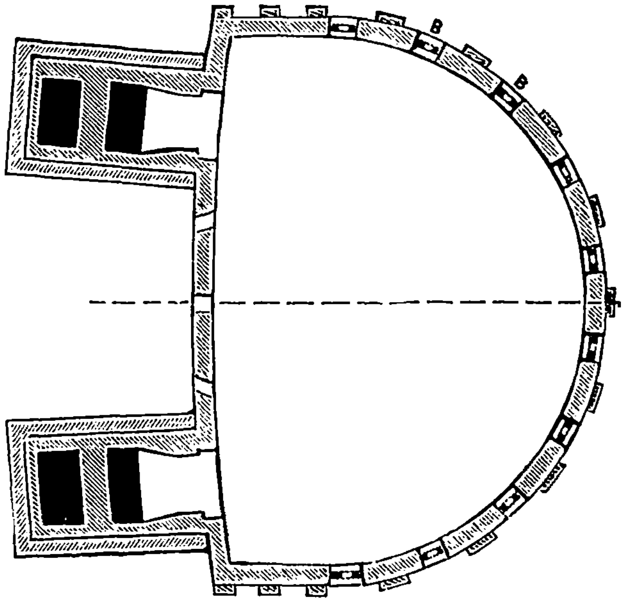


Fig. 6.

This new system of applying heat within the modified regenerative gas furnace has now been employed for a sufficiently long period to establish the economy of the method, as well in regard to the fuel used as to the material of which the furnace is constructed, and that treated on its hearth. One of the latest and most interesting applications has been to the open-hearth steel-melting furnace. At the Landore Works, the furnaces which were altered nearly eighteen months ago are still at work—a result entirely unprecedented in this class of furnace, which, as is well known, is worked at the very highest temperatures employed in the arts. But besides the longevity of the furnaces, they are found to work more uniformly, whilst the yield is larger, owing to there being less oxidation of the metal, as is proved by more ore being used per ton of pig iron, in order to decarburise it to the same extent. The furnaces work much more uniformly, and with great economy as regards consumption of fuel. Various other steel works throughout the country, and several glass works, are now modifying their furnaces so as to obtain the benefits offered by this new method of heating.

Another important application is to forge, mill, and puddling furnaces, as, owing to the absence of contact between the flame and the materials with which the furnace is charged, a great reduction in the loss of metal which has hitherto occurred through oxidation will be effected.

In steel re-heating furnaces, contact of the flame with the ingots produces red-shortness in the metal, exhibiting itself in fissures, particularly at the corners of the ingots or blooms, when these are subjected to treatment either under the hammers or in the rolls. The removal of the injured portions involves a stoppage of the operations, resulting in waste, not only of material but of time also, and occasionally rendering the blooms entirely useless for the purposes intended. In the radiation furnace this cause of loss no longer exists, while there is also a saving due to non-oxidation of the metal.

In iron re-heating furnaces the saving in waste of metal will be much more considerable than in furnaces for the re-heating of steel, owing to the higher temperature at which they are worked, and the metal will weld much more easily, as it is heated out of contact with flame. These furnaces should be made as long and wide as convenient, in order to obtain as much room for the development of the flame as possible, and for placing the ingots, blooms or packets sufficiently far apart to allow the radiant heat to reach them on all sides.

As regards puddling, it might be advantageous to erect a furnace containing a number of pans, which could either be placed in two rows, the men working at each face of the furnace, or the men could work on a semi-circular face by constructing the furnace of a horse-shoe form. The side of each pan should be separated from the next by a partition containing air in circulation, or by a water channel.

In the same manner, a furnace heated by radiation from flame may be constructed of such size and productive capacity, that it may serve for heating all the metal for a mill or forge, or, at anyrate, two or three such furnaces should suffice for the output of several hundred tons of metal per day, the only consideration being the convenient location of the furnaces with regard to the position of the mills and hammers.

In heating furnaces constructed and worked, as hitherto, by contact of flame with the metal to be heated, the furnaces must necessarily be made as small as possible; for the flame under such conditions parts with its useful heat in a run of a few feet, after which the sooner it leaves the furnace the better. But when heating by radiation is adopted the conditions will be quite changed, for the flame not being brought into contact with surrounding objects (including the metal to be heated), will be kept at a uniform temperature throughout its course, radiating all the time the maximum heat required for the charge in the furnace; and when combustion has ceased, the hot gases will be deprived of their remaining heat through contact in the regenerators. It will perhaps be difficult for those accustomed to heat metal by contact with flame, to realise the possibility of effecting the same object better, more quickly and more efficiently by means of radiation; but to overcome the difficulty it is only necessary to associate heating by radiation exclusively with the regenerative gas furnace, in which both air and gas are raised to a high temperature before combustion, as without such initial heating a flame of high temperature, and one therefore capable of radiating intense heat, could not be obtained.

Bearing in mind that contact of flame with the metal to be heated is avoided, there is no reason why a heating furnace should not hold at the same time piles, blooms, or ingots in various stages of heating, from cold metal to metal which is ready for the hammers or mills. Each individual bloom, pile, or ingot will, under such conditions, take up from the heat radiated by the flame, only the amount which it is susceptible of receiving without interfering with its neighbour; but the blooms, piles or ingots must be placed sufficiently far apart to allow the radiant heat to reach them from all sides. In such an application it would be advisable to arrange the blooms or packets in the furnace, so as to form graduations of heated metal, in order that a cold bloom or packet, on being introduced into the furnace, may not be placed next that which is hottest at the time.

The new method of heating by radiation from flame, thus offers the solution to an objection which has sometimes been made against the regenerative gas furnace on the ground of its great cost, which has certainly limited its application for heating furnaces at iron and steel works in this country; but, when a few, or perhaps one furnace only, will be built for a mill, the capital expenditure on furnaces, even with separate boiler settings, should compare favourably with the cost of the old grate furnaces and boilers. Moreover, they will offer the advantages of saving in fuel, in wear and tear, and in metal.

Manufacturers who think that the suggestion which has been made is in advance of the times, and who might doubt the possibility of obtaining a flame of such a considerable length as would be required for a furnace to heat 100 or 200 tons of metal per day, will be pleased to learn that the problem has been already solved by the author in connection with the manufacture of glass. There exist many furnaces of the dimensions now foreshadowed for heating iron and steel, some of which have a run of flame of upwards of 40 feet; and one of them, measuring 42 feet by 16 feet 6in. inside dimensions, holds 130 tons of glass, is capable of producing 24 tons of glass per day, or at the rate of a ton of glass per hour, the consumption of fuel being about 18cwt. per ton.

These furnaces hold at the same time freshly charged (cold) batch and refined glass, the charging of batch and the gathering of refined glass being continuously carried on in same chamber.

On the present occasion it is not necessary to refer to details of the glass furnaces constructed respectively on the old and new principles, which the author has erected; but it may be well to state that the advantages of the new system are quite maintained. Thus fewer pot breakages occur, the loss by waste glass continues to diminish, and fewer repairs are required; moreover, a superior quality of glass is produced from a cheaper composition than hitherto employed. The gross results are that the new furnaces last six times as long, and melt more than nine times the quantity of material that they did previously to their reconstruction. The flame being kept away from the working holes, the glass-blowers work more at their ease, turn out a better product, and are able to reheat their glass in the furnace without tarnishing it.

With these advantages, and others of a minor character, a glass-blower is able to produce 50 per cent. more goods without much greater exertion. In another furnace in which lamp glass chimneys are made, a more refractory material is employed than hitherto, and the glass produced is whiter and of better quality, whilst open instead of closed pots can be used for the production of superior qualities of glass, whereby a great saving in pots and fuel is effected.

Another most important application for the greater extension and improvement of which trials are now being made, is to the heating of boilers by means of gas; but in order to obtain the greatest benefit from this method of firing, it is necessary that there should be use for the gas made in the producers by night as well as by day. If flame is allowed to touch the sides of a boiler there is of necessity smoke produced on its inside surfaces, and the radiant heat of the flame not being able to penetrate such an atmosphere of smoke, the water in the boiler cannot get the advantage of it. It will readily be perceived how great a quenching effect the metal of the boiler has upon a flame, when it is remembered that the temperature of steam—which is, of course, that of the boiler—is only 311° F., even at 60lb. pressure, whilst that of the gaseous flame in contact with it is about 2000° F. In this application the principle has been followed of allowing the active flame to have free space for its development, and for the radiation of its heat within the length of the tube, and not allowing it to touch the sides until after complete combustion has been effected, when the products of combustion may be brought into direct contact with solid bodies. The way in which this is arranged is shown by the diagram Fig. 7, and by means of the little working model exhibited. The illuminating gas with which this model is supplied is deteriorated by partial combustion before reaching the flame outlet, so that it may be taken in that condition as not better than producer gas. If the flame was allowed to play along the tube in the ordinary way, it would very soon strike against the upper surface, producing smoke and soot, but by the arrangement of deflector rings inserted in the tube, the gas is not allowed to touch the surface of the tube until after complete combustion has been effected; and it will be noticed that by this means the flame has no discolouring effect on the tube. By this arrangement perfect combustion is produced, and there is no smoke. But besides this, a boiler fired in this manner lasts longer, because the flame being out of contact with the plates, these are not worn away so readily, boilers being more rapidly destroyed through direct contact with the flame than from almost any other cause. As the remaining heat of the products of combustion come into direct contact with the sides or flues of the boiler and its regenerators, it is completely utilised, and the maximum of heating effect is thus ensured.

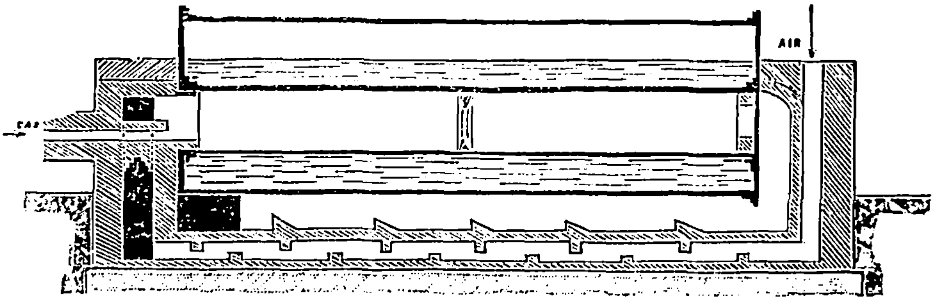


Fig. 7.

Thus, in various applications that have been made, a saving in fuel has been effected which varies from twenty-five to thirty per cent. These results refer to ordinary horizontal flued boilers, to which only this method of heating has been so far applied; but a vertical boiler is being constructed by the author specially designed for the application of radiant heat, from which it is expected that even better results will be obtained.

Another valuable application which has been suggested by Professor Armstrong, F.R.S., is to the manufacture of coke in the ordinary beehive oven. A furnace for this purpose would be very similar in construction to the glass-melting furnace of horseshoe form, shown in Figs. 5 and 6, the flame radiating heat of a very intense character upon the coal to be carbonised, the gases being drawn away below the bed of the furnace by means of an exhauster, in the usual manner. In order to prevent the flame being drawn down by the action of the exhaust, small coal (mixed, perhaps, with tar) should be charged on the top of the mass of coal to be carbonised, so that on heat being applied it would bind the upper surface, forming a skin impermeable to the passage of gases. The gases withdrawn from the bottom of the furnace may be led away for the removal of bye-products, and then re-delivered to produce the heat required for carbonisation, and also utilised for other purposes.

There must be several applications of the radiation furnace to the chemical industries, which should offer important advantages. In some cases gas has been used with the sole object of avoiding the introduction of ashes or dust into the furnace; but where contact of the flame is not necessary as regards the chemical operations performed, the utilisation of the heat by radiation first within the heating chamber, and by contact afterwards with extended surfaces, will be a great step in advance of the mere application of gaseous fuel. It is hoped, therefore, that this paper will prove of interest to the members of this Society, and that it will lead to an interesting discussion.

On the motion of Mr. Muspratt, seconded by Mr. Crowder, a vote of thanks was unanimously accorded to Mr. Siemens for his paper, and it was resolved to defer discussion upon it until the paper had appeared in the Society's Journal.

On the motion of Mr. Tyrer, seconded by Mr. Crowder, a vote of thanks to the authorities of the City and Guilds Institute for the use of their rooms was carried by acclamation, and the proceedings terminated.

THE ANNUAL DINNER.

The annual dinner of the members of the Society of Chemical Industry was held in the Freemason's Tavern, Great Queen Street, on Tuesday evening.

About 130 members and friends were present. The chair was occupied by the President (Dr. W. H. Perkin, F.R.S.), who was supported by Sir F. A. Abel, Mr. E. K. Muspratt (the President-elect), Sir J. McGarel Hogg, Mr. Walter Weldon, Professors Hugo Müller and Odling, Mr. David Howard, Mr. Ludwig Mond, Mr. E. Rider Cook, Professors Armstrong, Tilden, Meldola and others.

The first toast proposed was the usual loyal one. Mr. E. Rider Cook then proposed "The Houses of Parliament," responded to by Sir J. MacGarel Hogg, M.P. (Chairman of the Metropolitan Board of Works). "The Learned Societies" was the next toast, proposed by Mr. Ludwig Mond, and acknowledged by Dr. Hugo Müller, F.R.S. (President of the Chemical Society), and Dr. W. Odling, F.R.S. (President of the Institute of Chemistry). "The Society of Chemical Industry," was now proposed by Mr. Walter Weldon, F.R.S., and replied to by Mr. E. K. Muspratt. "The President" was the next toast, proposed by Sir F. A.. Abel, C.B., F.R.S., and responded to by Dr. W. H. Perkin, F.R.S. Mr. David Howard then proposed "Our Guests," a toast which was suitably replied to by Dr. Löwenherz. The toasting was finally concluded by the President proposing "The Officers of the Society," which was responded to by Mr. Watson Smith and Mr. Tyrer. Interspersed with the toasts were several vocal and instrumental pieces, ably rendered by Messrs. A. Zimmermann, Max Schrattenholz, and F. J. M. Page.

THE EXCURSIONS.

MESSRS. ORLANDO JONES & CO.'S STARCH WORKS.

The first visit was on Wednesday morning to the starch works of Messrs. Orlando Jones, of Wandsworth. Divided into four parties, one of which was conducted by the head of the firm, the remainder by various other gentlemen, the company was led over the works, and the details of the manufacture of starch from rice were explained in a most interesting manner. The operation in this extensive and well-conducted factory, which probably excited most attention as being of a chemical nature, is that in which the gluten is dissolved and separated from the ground grain by treatment with dilute caustic soda solution. By a process of deposition and decantation the husk fibre and starch are separated. After working up into white masses the starch is cut into cubical blocks, and dried to a certain extent, when after packing in paper and placing in a drying chamber for three or four weeks, the starch is found with an apparently crystalline appearance, adding greatly to the beauty of the commercial article. The alkaline solution of the dissolved gluten, it is stated, is run off as waste, no use having been found for it. The fibre however is partly used in the moist state for cattle-food, whilst a portion is, after drying, submitted to a special treatment, and is then utilised by paper-makers for giving body to paper. A special product, which consists of a form of "wheaten flour," is prepared in these works. The bran which has been separated from the flour is finely ground and then restored to the latter, and in this lies the peculiarity of the preparation. A saccharine preparation is also manufactured from maize, after cleaning and crushing the grain.

MESSRS. JOYNSON & CO.'S PAPER MILLS

at St. Mary Cray were next visited, and here a luncheon was most kindly provided for the visitors. In these noted paper-mills were seen the several processes in their different stages, from the sorting of the rags, and the bleaching, to the manufacturing from the pulp of the finest brands of paper. Since only assorted rags are used, it is needless to say that only paper of the better and very best classes is made by Messrs. Joynson & Co.

THE BECKTON GAS AND CHEMICAL WORKS

were visited on Thursday morning, July 9th. A large party of about 400 were conveyed by the "Glenrosa," the finest boat of the London Steamship Company, from All Hallows Pier to the landing stage of the Beckton Gas Works, where the visitors were received by Mr. Trewby, the principal engineer. In these admirably conducted works the visitors were conveyed from one principal point of interest to the other by rail. The Beckton Gas and Chemical Works form the central station of ten other gas-works, carbonising about 1,500,000 tons of coal annually. It required no great perception, though it did some practical knowledge of the subject, to observe that the latest and best improvements in the arts of gas-making and tar-distilling are employed by this, the first, and we believe still the only, gas-company in the country supplying at once illuminating gas, pure coal-tar products, and dye-stuffs. In the gas works, the firing of the retorts with gas was an interesting feature, as also the mechanical and automatic apparatus for charging the coal into the retorts. In the tar distillery was seen to advantage the admirable system of setting the tar-stills referred to in Dr. Lunge's work on Coal-tar, *loc. cit.* pages 97, 98, and 99 (Fig. 4), so that the red-hot cinders never appear outside the stills, but are wheeled away under the same by a subterranean arched-passage, thus avoiding possibilities of fire or explosions. An interesting process for moulding naphthalene into corrugated sticks, for enriching illuminating gas by means of the well-known Albo-carbon lamp, was also witnessed in operation. The apparatus used somewhat resembles that by which a certain class of candles is made. The rectification of benzene, toluene, and xylene, is conducted in a well-appointed special department, and the fractionation is performed in a dephlegmating column. Sulphate of ammonia is manufactured in comparatively vast quantity in these works, the sulphuric acid used being prepared on the spot in extensive vitriol chambers. The chambers are supplied with sulphurous acid from pyrites burnt in the ordinary pyrites burners, and from spent oxide saturated with sulphur (from the oxide purifiers) burnt in shelf-kilns.

THE PUMPING STATION AT CROSSNESS AND DISINFECTANT FACTORY OF THE METROPOLITAN BOARD OF WORKS

was the next point of interest. At this station and factory an experimental process is being carried out for disinfecting London sewage. It was explained to the visitors by Mr. Dibdin, principal chemist to the Metropolitan Board of Works.

Manganate of soda is made, brought into dilute solution, acidified, and the acidified permanganate liquor well agitated with the sewage pumped up by gigantic pumping engines, working, despite the enormous amount of power expended, with wondrous silence. The water is afterwards returned, when disinfected, to the Thames at suitable periods of the tide.

THE NEW TILBURY DOCKS,

next visited, were interesting chiefly on account of the enormous scale on which the excavations and works generally are being carried on, as well as on account of the peculiar nature of the strata exposed in course of excavating. Mud deposits and peat bogs appear to have covered this neighbourhood at one time, and deposited in these now, at a depth of some forty feet below the normal surface, are still abundantly to be found in an excellent state of preservation, trunks and branches of trees, as well as occasionally animal remains. The inspection of these extensive docks by the visitors was greatly assisted by the subdivision of the party into groups, each headed by an engineer, who explained the operations in progress. The weather throughout the day was most propitious, and this event had much to do in making the excursion such an enjoyable one. As the steamer neared All Hallows Pier on the return journey, Mr. J. C. Stevenson, M.P., in a few well-chosen and kindly sentences, proposed a vote of thanks to the Local Secretary of the London Section, Mr. Tyrer, for the most effective way in which he had carried out the numerous and multiform arrangements necessary in organising such a meeting, and thus contributing so largely to achieve a result so eminently successful. The vote, responded to most heartily, was then acknowledged in a few words by Mr. Tyrer.

THE CONVERSAZIONE AND RECEPTION.

On Wednesday, at half-past eight, the presidents of the Chemical Society, the Institute of Chemistry, and the Society of Chemical Industry held a reception in the galleries of the Royal Institute of Painters in Water Colours, Piccadilly, W., where in the course of the evening about 1000 ladies and gentlemen assembled. The conversazione, amid surroundings so charming to the eye as well as to the ear, may be pronounced a brilliant success. An admirably-arranged programme of instrumental and vocal music, under the direction of Miss Adelaide Thomas, was carried out to perfection, with the assistance of Miss Mary Thomas, Miss Riley (violin), Mons. Albert (violoncello), Mr. Tapley (vocalist), and Mr. Marshall (accompanist). Conspicuous in this programme was the beautiful trio in D Minor by Mendelssohn for pianoforte, violin and violoncello, which was exceedingly well performed by Miss Adelaide Thomas, Miss Lucy Riley, and Mons. Albert.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.
H. E. Armstrong.
W. Crowder.
C. Graham.
S. Hall.
A. K. Huntington.
R. Messel.

B. E. R. Newlands.
B. Redwood.
T. Royle.
John Spiller.
G. C. Trewby.
W. Weldon.
J. Williams.

Local Sec. and Treasurer: Thos. Tyrer,
Garden Wharf, Church Road, Battersea, S.W.

MEETINGS, SESSION 1885—First Monday in each month (unless otherwise indicated).

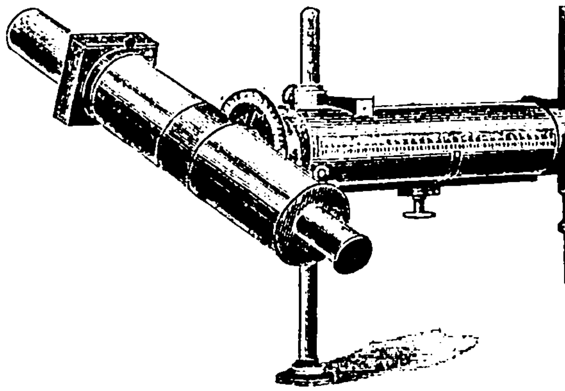
Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held June 1, 1885.

NOTE ON PROFESSOR LEONHARD WEBER'S PHOTOMETER.

BY BOVERTON REDWOOD, F.C.S., F.I.C.

THIS instrument consists essentially of two tubes attached at right angles, in the form of the letter T, in such a manner that, while one is supported in a horizontal position, the other can be placed horizontally, or at any required angle. At the junction of the two tubes is a reflecting prism, by means of which, in combination with a diaphragm, the field of vision of an observer looking into an eye-piece, which forms one end of the movable tube, is divided vertically into two equal portions. One-half of the field is illuminated by the light passing through the movable tube, and the other half by light passing through the fixed tube. The source of the light passing through the fixed tube is a small lamp burning petroleum spirit. This lamp furnishes the standard light, and a scale is attached to enable the observer to measure accurately the height of the flame. Inside the fixed tube, between the petroleum lamp and the reflecting prism, is a frame, carrying in a vertical position a circular plate of opal glass, and travelling along the tube, from end to end, by means of a rack and pinion. At one end of the movable tube (the other end being furnished, as described, with an eye-piece) is a holder, in which a rectangular plate of opal glass (or, if desired, two or more of such plates) is placed. The petroleum spirit lamp having been lighted, and the flame adjusted to the height of two centimeters, the light to be measured is placed at a convenient distance from the rectangular glass plate (usually 1 meter), and the eye of the observer being applied to the eye-piece, the travelling opal glass plate is moved by means of the milled head of the pinion until the two halves of the field of view are equally illuminated. The position of the travelling opal glass plate is then read off on the graduated scale attached to the fixed tube, and the illuminating power calculated by means of the table of values supplied with the apparatus. It is obvious that the travelling opal glass plate, being illuminated by the petroleum lamp, becomes itself, to some extent, a source of light; and the amount of illumination of one-half of the field, therefore, depends partly upon the proximity of this plate. If it is found that the light to be measured is so powerful that the standard side of the field is not equally brightly lighted, even when the travelling plate is brought as closely as possible to the reflecting prism, at the junction of the two tubes, the light may, of course, be removed to a greater distance, or a second opal glass plate may be inserted in the holder. Under ordinary circumstances both tubes of the photometer are in the same horizontal plane; but if it is desired to measure the illuminating power of angular rays, the movable tube, which is fitted with an arc divided into degrees, may be placed at any desired angle. The apparatus is also applicable to the measurement of diffused light.



The formula for calculating the illuminating power (B) of a flame from the readings obtained with the instrument, is: $B=k.C\frac{R^2}{r^2}(a+bl)$ normal (standard) candles.

In this formula the factor $k=1$ for such lights as are of the same colour as the standard light, C is the constant of the rectangular opal glass plate, R is the distance of the centre of the light to be tested from the rectangular plate, and r the distance of the standard light from the circular travelling opal plate. a and b are constants relating to the standard light, and l the length of the flame of the standard light. a and b have the respective values of $-0{\cdot}88$ and $+0{\cdot}94$, and are so calculated that when $l=2$ (the normal height of the flame being 2cc.) $a+bl=1$. Accordingly, when the height of the standard flame is maintained at 2cm., the expression $(a+bl)$ may be omitted from the formula. Moreover, when the standard flame is maintained between 1·9 and 2·1cm., the expression $(a+bl)$ may still be omitted, and the result corrected by subtracting or adding as much per cent. as l is tenth millimeters longer or shorter than 2cc. With each apparatus the values of the opal plates are furnished; but in the printed description of the apparatus Professor Weber describes how these values may be experimentally verified.

The photometer is remarkably portable and compact (it packs into a box 21in. by 10¾in. by 6in.), and it requires for its use no specially prepared dark room.

The principle of bringing the light passing through two tubes into a divided field of vision for comparison, has long been adopted in the construction of chromometers for liquids; but the writer believes that the credit of applying it for the measurement of light belongs to Professor Weber.

The writer is not in a position to express any confident opinion as to the merits of the instrument; but he hopes at a future date to give the results of his experience in its use. Opinions, however, frequently differ so widely in regard to photometric appliances that the experience of an individual appears to be of comparatively small value, and the writer's object in making this brief communication is to direct attention to Professor Weber's invention, in the hope that others engaged in photometric work may be induced to give the apparatus a trial. In the meantime the writer may mention that he saw the instrument in use in the laboratory of the Normal Aichungs Kommission, in Berlin, and was informed that the results obtained with it compared very favourably with those furnished by the ordinary photometer.

DISCUSSION.

Messrs. F. W. **Hartley**, W. **Dibdin**, and Dr. P. F. **Frankland** criticised the details of construction of Professor Weber's photometer, and specially complained that operators were left with arbitrary standards, even more than in the older forms of photometer.

Mr. **Redwood** pointed out that he had claimed nothing as yet for the instrument; but he should feel it incumbent upon him to give the benefit of his investigations in a future communication.

◆

ON THE SOLUBILITY OF NITRIC OXIDE IN SULPHURIC ACID.

BY G. LUNGE.

In some recent communications to the Chemical Society I have mentioned the analytical operation performed by means of the "nitrometer," described by myself sometime ago. Mr. A. H. Allen has lately described a number of new and highly interesting applications of this apparatus.* In this paper he has mentioned a few circumstances which he considers as drawbacks, to be avoided by special means. One of these is the formation of a persistent mercurial froth, which delays the reading. Allen mentions a way of avoiding this delay, but I do not think it even desirable to do so, as a certain time should elapse after shaking the apparatus, both to give time for the temperature of the gas to be equalised with that of the surrounding air, and for allowing all the acid to run down from the sides of the measuring tube. The froth sometimes observed at the top of the acid, which is far more troublesome, is easily avoided by a sparing use of grease in the glass tap, and when employing vaseline I have never been troubled at all with such froth.

It seems a more serious objection that Allen believes sulphuric acid to have a notable solvent power for nitric oxide; hence he recommends the acid to be diluted below that point where this solvent action becomes appreciable, in the proportion of three measures of strong acid to two of water. Allen bases this upon experiments made at his request by Mr. T. Bailey, according to which, in the case of acid of sp. gr. 1·62, the extra gas obtained after further diluting was fully 0·5cc. With stronger acid this source of error is said to become even more serious.

If Bailey's experiment were to be trusted, even the dilution recommended by Allen would not be sufficient, for strong oil of vitriol at 1·84, diluted with two-thirds its volume of water, yields acid of 1·62, at which strength Bailey asserts it to retain still 0·5cc. of gas. If this were correct, one could only wonder that thousands of tests had been made without noticing so grave an error. But this is not the case; the following shows that Bailey's result can only be accounted for by an experimental error, perhaps just in consequence of taking the reading with too little delay.

C. Winkler and J. Kolb have tested the solvent power of strong sulphuric acid for nitric oxide. Both of them found it not appreciable, the acid not having any action upon potassium permanganate, after NO, free from air, had been passed through for a long time. These experiments had to be repeated in order to discover any slight action overlooked by Winkler and Kolb. First of all I operated by shaking up from time to time from 6 to 12cc. of sulphuric acid with pure nitric oxide in the nitrometer, reading the volume of gas, diluting with from 4 to 10cc. of water, shaking again, allowing to cool down, adjusting the levels properly and reading again. This was repeated a good many times with new quantities of acid. The increase of the volume of gas on diluting the acid amounted to 0·05 up to at most 0·15cc.; the larger amount was found when diluting more strongly, and was evidently caused by the vapour tension of the dilute acid. The real increase of volume is only 0·05 or at most 0·10cc.—a magnitude to be neglected in most cases, whilst 0·5cc., as stated by Bailey, would cause a gross error. But even the small amount found in the above-mentioned tests probably is not caused by any evolution of NO, as will be seen from the following.

I now made a direct test of the solubility of nitric oxide in sulphuric acid. This I did as well by means of my nitrometer, which is most eminently adapted for this purpose, *and is altogether in many cases the*

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* *Journal of the Society of Chemical Industry*, 1885, p. 178.

most convenient absorptiometrical apparatus. A given quantity (from 15-20cc.) of very pure sulphuric acid was introduced into the measuring tube; the air was expelled by raising the level tube; the three-way tap was so placed that the cup communicated with the lateral bore, whereupon the cup was rinsed and dried. Now the tap, still in the same position, was connected with the drying tubes of a gas holder containing nitric oxide, and dry NO was passed through until all air had been expelled from the connecting tubes and the cup. The tap was now turned 180 degrees, so that the lateral bore communicated with the measuring tube; by lowering the level tube a few cc. of NO were drawn in, the tap was closed and the connection with the gas holder severed. The cup was filled with water, in order to remove the NO, the water run off by the lateral bore of the tap, and the cup dried. Now the contents of the nitrometer were thoroughly shaken up from 50 to 100 times, which can be done much more conveniently than with Bunsen's heavy absorptiometer. The level tube was now placed so that the mercury balanced not merely the pressure of the column of acid within the measuring tube, but also the difference between the actual barometrical pressure and 760mm. (Of course it would have been easy to work at a lower or a higher pressure, which is just a special advantage of this apparatus.) After standing some time, the gas was driven out of the measuring tube by raising the level tube and opening the tap, and the latter was sideways connected with a narrow glass tap burette, which allowed reading up to 0·01cc. A current of CO_2 had previously been passed through the burette, and this was continued to the end of the titration, in order to prevent the air from acting upon the NO dissolved in the acid. The acid was now forced over into the burette, and was run from this into a very diluted, but exactly titrated solution of potassium permanganate, until the colour was discharged. Since very slight quantities had to be estimated, only 1cc. of a solution was employed, whose oxidising power was equal to 0·000196grm. O or 0·000245grm. NO; this was diluted and gently heated before running in the acid. Previously it had been found that 1cc. of the permanganate required 28cc. of the acid before treating it with NO; hence for each cc. of strong acid used in titrating, 0·036cc. permanganate had to be deducted.

The observations yielded the following results:—

(*a*) Concentrated sulphuric acid, of sp. gr. 1·84 = 96 per cent. H_2SO_4, saturated with NO at 18° C. and 760mm. pressure, in two experiments absorbed so much NO that 4·33 resp. 4·22cc. of acid was required to decolourise 1cc. of permanganate; that is a mean of 4·28cc. Deducting from this $4·3 \times 0·036 = 0·15$, there remains 4·13cc. acid—*i.e.*, 1cc. acid = 0·242cc. permanganate = 0·0000593grm. NO = 0·035cc. NO.

(*b*) Dilute sulphuric acid, of sp. gr. 1·500 = 60 per cent. H_2SO_4, absorbed so much NO at 18° C. and 760mm. pressure, that in two experiments 1cc. permanganate required 8·42 resp. 8·90, or a mean of 8·66cc. acid. Deducting 0·15, there remains 8·51cc., or 1cc. acid = 0·117cc. permanganate = 0·0000287grm. NO = 0·017cc. NO.

Since the acid *a* must be mixed with an equal volume of water to produce the acid *b*, 0·017cc. NO in 1cc. of the acid *b* corresponds to 0·034cc. NO in 1cc. of the acid *a*. In reality the latter had only contained 0·035cc. NO. *Hence on diluting acid of* 1·84, *saturated with* NO, *with an equal volume of water no nitric oxide at all is set free.* Therefore Bailey's observation must be erroneous, and it is not possible to correct any presumed error in the nitrometer readings by dilution with water. But that error, according to the above experiments, is so slight that it need not be taken into account in any ordinary case.

Mr. Allen's valuable paper has caused me to take up the question of further uses of the nitrometer. I cannot, for most purposes, approve of his plan of substituting strong brine and the like for mercury; and I consider this a distinct and quite uncalled-for deterioration of the capabilities of that apparatus, except in a very few cases—for instance, when testing sweet spirit of nitre. Otherwise, I prefer attaching to the side of the three-way cock a light flask, with an inside tube soldered on to its bottom, and connected with the cock by means of a short stout caoutchouc tube, so that it is suspended without any other support. In this I perform the analyses of sodium and potassium carbonate and bicarbonate, of caustic soda or lime (for carbonate), of calcium carbonate, marl, etc., of manganese ore by means of oxalic acid, of oxalic acid or oxalates by means of MnO_2, of acids, especially acetic acid, by means of carbonates, of the free acid in many metallic salts, and so forth; always employing Dietrich's tables for the solubility of CO_2 in the liquid (Scheibler's co-efficient is altogether wrong). The alkaline bromine solution serves in the same apparatus, not merely for the estimation of urea, but for that of ammonia salts; in both cases taking into account the incompleteness of the reaction, which in the case of urea amounts to 9 per cent, in that of ammonia salts to 2½ per cent., of the total quantity. The evolution of equal parts of oxygen from hydrogen peroxide and an acidified solution of potassium permanganate can be utilised not merely for testing the former, but equally so for the latter, by employing an excess of H_2O_2; and I find this a perfectly correct way of standardising permanganate solutions, without the aid of balance, or weights, or substances of known composition. Moreover, I find that bleaching powder and manganese ore can be equally well estimated by means of H_2O_2, and H_2O_2 by the former, the evolution of oxygen following precisely the same law as with $KMnO_4$. I have made a great many experiments on all these points, and I find that the nitrometer can be generally employed for all analytical operations in which is evolved a definite quantity of a gas, not soluble to a very considerable extent in the liquid from which it has been evolved, and not acting upon mercury. By a contrary reaction I employ the nitrometer for estimating indigotin in reduced solutions of indigo, by means of the absorption of oxygen. The same apparatus serves very well for measuring and analysing the gases dissolved in water or other liquids. I also utilise the nitrometer as a general apparatus for gas analysis, but in a totally different way from that employed by Mr. Allen—viz., in some cases by acting upon the gases within the measuring tube itself, in others by attaching to its tap Hempel's absorbing pipettes. To all these purposes my nitrometer is adapted by the three-way cock, which is wanting in those other pieces of apparatus whose authors have adopted the name brought forward by me. That cock can be replaced by a plain one when employing the nitrometer as an apparatus for reducing volumes of gases to normal conditions of temperature and pressure, by confining in it a certain volume of air which occupies exactly 100ccm. at 0° and 760mm. All this and several other matters have been described in more detail in the June number of the *Chemische Industrie*, and in the English translation of Clemens Winkler's "Manual of Technical Gas Analyses," now in the press.

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Notices of papers and communications for the Meetings to be sent to the Local Secretary.

ERRATUM.—In Mr. FAWSITT's paper on "Wood Naphtha," printed in the May issue of this Journal, the following error occurs:—In the 6th line of the small table of the Constituents of Wood Naphtha in column 1, page 320, "Di-methyl Acetate" appears instead of "Di-methyl Acetal."

Communication.

ON DR. CLARK'S PROCESS FOR THE ESTIMATION OF SULPHUR IN PYRITES.

BY G. LUNGE.

IN the *Journal of the Society of Chemical Industry*, May, 1885, p. 329, Dr. Clark describes a new dry process for estimating sulphur in pyrites, which, according to Mr. Tatlock's expectation, is destined to revolutionise the analyses of pyrites. Dr. Clark thinks his process called for, since the ordinary wet process involves certain errors which do not exactly counterbalance each other; but he admits that the wet process, if properly carried out, yields very constant results, and this is indeed best proved by his own experiments as quoted p. 330. His own method generally yields results about ½ per cent. higher than those of the wet process. I shall not stop to inquire whether Dr. Clark's method is really preferable to the dry methods previously known, especially that of Fresenius. But it is strange that in mentioning the various papers published on the estimation of pyrites by Fresenius and myself, Dr. Clark should have omitted to notice *why* I had objected to Dr. Fresenius' method. My reason for rejecting *any* dry process for the estimation of sulphur in pyrites is that in this way we estimate also the sulphur of galena (which is nearly always present) and of the sulphates of barium and calcium, none of which are of the least use to the consumers of pyrites, whilst in the wet process nearly the whole of that useless sulphur is left behind in the insoluble residue. I should therefore, on behalf of the buyers, strongly deprecate the introduction of Dr. Clark's or any other dry process as the ordinary trade analysis of pyrites, or even the optional use of it by commercial analysts. In this case I cannot agree with Mr. Tatlock that chemists have nothing to do with these matters, their sole concern being to render methods of analysis as perfect as possible. It is a delusion to speak of a more complete estimation of sulphur in pyrites, as something fair and just. Pyrites consumers do not want to buy galena or heavy spar, they want to buy *pyrites;* the chemists who regulate the price to pay for a special parcel by their analysis are not supposed to perform a scientific operation, irrespective of all other considerations, as they would have to do when working for theoretical purposes, but it is their duty to employ such methods that the results indicate *what the article in question is worth.* This value is entirely depending upon the sulphur of the pyrites itself, and if the chemist in his certificate returns the total sulphur, including that of galena, heavy spar, etc., he actually deceives the buyer as to the value of the ore in question.

Before my process of testing pyrites was generally adopted between buyers and sellers in Germany, there were constant disputes owing to the discrepancies between the returns of different chemists; since that time I am informed that there are hardly any disputes of that kind. Fresenius himself has tacitly given up his opposition to my process; and Dr. Clark's process would be as objectionable in the above respect as that of Fresenius. It is not likely that in future pyrites consumers will quietly submit to paying for an additional half per cent. of sulphur which is of no use to them, and I do not doubt that the attempt to "revolutionise" the analyses of pyrites in this way will fall to the ground.

Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Refrigerating Machines for the Production of Clear, Transparent Ice. Dingl. Polyt. J. **256**, 69.

THE "Gesellschaft für Linde's Eismaschinen," Wiesbaden (Ger. Pat. 26,981, July 10, 1883).—A series of lancet-shaped paddles is suspended in the freezing tank, which, working by means of a mechanical arrangement, keep the water in motion. The speed of the circulation, through the peculiar construction of the apparatus, decreases in the divisions of the tank with the fall in the temperature of the water. O. Kropf, Nordhausen (Ger. Pat. 28,230, February 16, 1884), recommends for the same purpose the employment of a suction and pressure pump. A. Schwirkus, Berlin (Ger. Pat. 30,031, March 18, 1884), adds lime, and frees the water from gases by means of an air-pump, previous to freezing it.

—F. M.

Improvements in the Manufacture of Ice and Apparatus therefor. H. H. Lake, London. Eng. Pat. 9651, July 1, 1884.

THE invention refers to improvements in that class of ice-making machines in which cold is produced by vapourising water by means of a vacuum maintained through the rapid removal of vapour as formed, the chief object of the invention being the construction of an improved machine for the production of a block of ice by that method and for its removal when formed. In carrying this out in one way, the inventor uses an inclined cylindrical vessel provided with a piston upon an axis or shaft, which piston on rotating over the mouth of a basin filled to the brim with water, covers one-half of its lower surface with a thin film of water, the other half of its surface being exposed to the refrigerating influence of a vacuum. As the piston revolves it exposes to the cold a continued film of water, and thus gradually increases the thickness of the coat of ice on its lower surface, provision being made for the piston to yield by sliding along of or with its shaft to make room for the increasing thickness of the ice. Upon completion of the block, the upper part of the inclined vessel, together with the piston and its axis holding the block, are removed, and on the admission of steam through the shaft and into the hollow piston, the block is released and slides off. Other arrangements with horizontal and vertical cylindrical vessels, and including various methods of producing the film of water, are described, and special provision is made in every modification of the apparatus with the view to preventing the exposure to evaporation of any portion of the water used, excepting that which constitutes the film for congellation. By this means the inventor calculates upon maintaining a constant supply of fresh liquid surface for freezing. Sulphuric acid may be employed in aid of the absorption of the vapour abstracted from the vessel, or cold air may be blown into the vessel for the purpose of freezing the film of water, instead of making use of the principle of evaporation in vacuo. The specification is illustrated with fifteen sheets of drawings.—B.

II.—FUEL, GAS, AND LIGHT.

The Heat of Combustion of Ronchamp Coal. M. Scheurer-Kestner. Bull. Soc. Chim. Oct. 5, 1883.

This is an account of an experiment undertaken by the author to verify some results obtained by himself and M. Meunier-Dollfus fifteen years ago, which have been disputed by MM. Bunte and Stohmann. The calorimeter used was a Favre-Silbermann, just as in the original experiment. Below are shown the composition of the coal (ashes being deducted), and the results obtained compared with those obtained for samples of *nearly similar composition in 1869* :—

	No. 1 Sample, 1869.		No. 2 Sample, 1869.		Present Sample, 1881.
Carbon..................	89·96	...	88·38	...	89·09
Hydrogen	5·09	...	4·42	...	5·09
Nitrogen	1·28	...	1·20	...	1·30
Oxygen and Sulphur	3·67	...	6·00	...	4·52
	100·00		100·00		100·00
Heat of combustion (calories) ...	9167	...	9117	...	9130

—A. R. D.

Improved Means for Generating Steam by Chemical Agents. Amended Specification. H. H. Lake, London. From H. Grüneberg and E. Harat, both of Cologne. Eng. Pat. 4295, March 3, 1884.

In the original specification it was proposed to employ the heat developed by the combination of lime or concentrated sulphuric acid with water for the generation of steam. The amendment consists in the omission of sulphuric acid, leaving caustic lime as the sole agent.

—A. R. D.

Improvements in Apparatus to be employed in the Manufacture of Candles. L. J. Pirie. Per Carpmael & Co. Eng. Pat. 12,954, Sept. 29, 1884.

In moulding candles with conical fluted ends, rings are employed to mould these ends. The purpose of the apparatus described is to free the thick ends of the candles from these rings, and it is applicable to the ordinary candle-moulding machines in use in England. It consists essentially of a subsidiary frame with rails, upon which the candles are laid horizontally, after being pushed out of the moulds in the ordinary way; one of these rails is movable, and works a set of plungers, forcing the candles out of the rings, while the rings are themselves retained in their place by another rail.

—W. L. C.

Improvements relating to the Manufacture of Coke, and to Ovens therefor. H. H. Lake, London. From Messrs. Wirth & Co., Frankfort-on-the-Main (Agents of Franz Brunck, Mannheim). Eng. Pat. 8453, February 27, 1885.

According to this invention, the retorts are of cup-shaped section, and the side walls thereof are as nearly vertical as possible. This prevents the formation of injurious cracks in the coke-cake, and allows the walls to be very thin, but nevertheless strong. To increase their stability, the partition walls and the heating flues between the retorts rest upon the arch of the heating channel or furnace below. Wherever possible, the coal in the retorts is compressed when filled, and a furrow or trough is made in its upper surface to secure a more equable distillation. With a view to enable the coke-cake to retain its heat, this trough or furrow is filled with lime, small coke, or the like. Any mechanical device for compressing the coal and making this trough may be used. Small coke powder added to the coal, and well mixed, has the effect of reducing the number of injurious cross-cracks. Coals rich in gas, and also in water, are mixed with tar and pitch, and made into bricks of a pierced or stellate section, so that the moisture may the more readily escape in the coking process. From the retorts the coke is drawn into a train of slaking waggons which pass below the retort doors. Instead of falling direct into these, it tumbles over sloping, pierced surfaces, or grates, which allow the small coke to pass through, and deliver only pieces of the proper size into the waggon.—A. R. D.

Improvements in the Manufacture of Hydrogen Gas. A. H. Reed, London. From G. E. Moore, New York. Eng. Pat. 3776, March 24, 1885.

This is a process for treating hydrogen and carbon compounds for the oxidation of the carbon to carbonic acid, in which form it may be readily eliminated, leaving pure hydrogen. The hydrogen and carbon compounds, in a suitably divided state (generally as a gas or fine spray), are brought into contact with the oxide or oxides of iron, manganese, copper, tin, lead or zinc, in the presence of a steam jet. The metallic oxides must be raised to the temperature required by the process, and the steam is preferably superheated. During the operation, the oxides are said to be alternately reduced and reoxidised, acting as carriers of oxygen between the steam and the carbon compounds, so that all the carbon present is converted into carbonic acid, and leaves the chamber in which this is effected mixed with the hydrogen originally present and that resulting from the decomposition of the steam. The carbonic acid may be removed by any known method, such as absorption by lime, or by water under pressure, or by solution of alkaline carbonate.—A. R. D.

Improvements in and Apparatus for obtaining Gas from Hydrocarbons. J. F. Schnell, John Read, Jas. Warwick and William Derbyshire, Manchester. Eng. Pat. 9532, March 27, 1885.

This invention consists in impregnating atmospheric air with a mixture of "benzoline" and ether, or "gasoline." If for heating purposes, the proportions recommended are a gallon of the first to six ounces of the second or third. If the gas is specially required for illumination, one ounce of paraffin should be added. The impregnation takes place in a closed vessel, divided into compartments filled with pumice-stone. This vessel is filled to a certain depth with the hydrocarbon mixture, and the air is caused to pass through the crevices between the blocks of pumice—openings in the partitions directing it in a zig-zag course through the apparatus.

—A. R. D.

An Improvement in Gas Producers. Richard Howson Middlesborough. Eng. Pat. 13,467, April 8, 1885.

According to this invention, it is proposed to conduct the air blast downwards, instead of upwards, through the mass of fuel in the producer. The advantages are chiefly that it prevents the charging apparatus from getting unduly heated, while the tar and coal-dust issuing from a fresh charge of fuel are carried through a mass of glowing coke, and thereby vapourised. This also prevents the choking up of the flues.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Note with reference to the Methods proposed for Coking Coal and Recovering Volatile Matters. H. E. Armstrong. Jour. Iron and Steel Institute, 1885.

The author is of opinion that in coking coal, the mere collection of the volatile matters evolved is not sufficient for a satisfactory solution of the problem at issue, because, even if the operations be always so conducted as to yield coke of good quality, the quantity and character of the volatile products will vary considerably for each particular class of coal, according to the conditions under which coking is effected. The results obtained by Watson Smith in his examination of the tars from the Simon-Carvès and Jameson ovens, and from the Gartsherrie blast furnaces, afford ample proof of this. Although our knowledge of the chemical composition of coals is very imperfect, the author considers it in the highest degree probable that coals, especially those of bituminous character, for the most part consist of very complex compounds, which are not the mere residues of the primeval vegetation preserved to us as coal, but have resulted from the occurrence during the lapse of ages of a variety of complex chemical changes. The compounds present in ordinary "high-temperature" tars, such as are obtained in gas-making, and in the Simon-Carvès tar are not for the most part immediate products of distillation, but are formed from the latter by a variety of secondary chemical changes, which in part are of an analytical, and in part of a synthetical character. On the other hand, tars such as have been obtained from the Jameson ovens and the Scotch blast furnaces are said to more nearly represent the primary products of distillation of coal, and the author regards these as "low-temperature" products. The Simon-Carvès tar is said to closely resemble ordinary coal-tar, The Jameson tars, however, contain large quantities of paraffinoid hydrocarbons, such as occur in shale oil. The Simon-Carvès tar is stated to be equal in value to ordinary coal-tar; and, although reliable information on this point is wanted, the opinion appears to be gaining ground that the Simon Carvès tar is a satisfactory product, because it resembles coal-tar, whilst the Jameson tar, being unlike coal-tar, is an unsatisfactory product, and contains little that is of immediate value. Hence the Simon-Carvès oven has been strongly advocated as affording a solution of the problem at issue. The author is entirely opposed to this opinion, and considers, moreover, that chemically the method followed in coking coal in the Simon-Carvès oven is irrational as compared with that followed when coking is effected in the beehive oven as modified by Jameson. Coal-tar is a mere by-product of the manufacture of coal-gas, and in its production no attempt is made to secure a product having special qualities; it therefore by no means follows that because a product equal in value to ordinary coal-tar is obtained in coking coal, the best product which it is possible to obtain from the material at disposal has been secured, or that, in obtaining this product, much that is valuable has not been lost. Moreover, coal-tar is what the author terms a "final" product; it cannot well be dealt with in any way so as to improve its quality, whilst the Jameson oil is not a final product, since its quality can be improved. By passing it through red-hot retorts, it may be made to yield a considerable quantity of very rich illuminating gas, and a large proportion of benzene and other valuable products such as are present in ordinary coal-tar. (This Journal, vol. iii. 462.)

The author's objections to the construction of the Simon-Carvès oven are—firstly, because the heat is applied externally, and, therefore, more or less wastefully; and, secondly, because the mass of coal is first heated to redness on its exterior, and all the products of distillation are then necessarily forced to pass through a red-hot carbonaceous shell, thus giving opportunity for the occurrence of a variety of chemical changes which tend to deteriorate the product. His idea of a theoretically-perfect coke-oven is somewhat as follows:—It would consist of an oven resembling the present beehive oven, but with the upper part largely extended so as to form a furnace chamber of the type recommended by F. Siemens. Heat would be radiated upon the surface of the charge of coal, which would soon become coked, thus forming a protecting layer below which distillation would take place, the products being drawn away as rapidly as possible, and at as low a temperature as possible through the cool bottom of the oven. As slight an excess of air as possible, if any excess, being admitted to the furnace above, the small proportion of products of combustion which penetrated the upmost layer would carry no oxygen with them. On this account, and because of the large volume of steam and of other gases generated within the mass, and because of the low temperature, the ammonia would probably almost entirely escape destruction. The gas sucked away would be of low quality as an illuminant, and would be available for carbonising, oil and ammonia having been removed from it by efficient scrubbing.

—D. B.

Recent Results with regard to By-products obtained in Coking Coal in the Simon-Carvès Coke-Ovens. Watson Smith. Jour. Iron and Steel Institute, 1885.

In view of the fact that the Bear Park Company has recently started operations with fifty of the Simon-Carvès coke-ovens, with improved recuperating arrangements, and at the same time with a different class of coal to that used by Messrs. Pease (see *Jour. Iron and Steel Institute*, 1884, 2, 509; and this Journal, vol. iii. 505), the author gives an account of the results obtained by this firm in the direction of the recovery of by-products. The temperatures obtained in the Bear Park ovens are, if anything, higher than those at Pease's West, near Darlington. Analyses of the tars obtained at Messrs. Pease's and at the works of the Bear Park Company show that the tar obtained from the ovens employed by the Bear Park Company much more closely resembles normal gas-retort coal-tar than that obtained from the coke-ovens at Pease's West. It is generally richer in benzenes and phenol, and though less rich in naphthalene and anthracene, it is, nevertheless, still a tar very rich in these substances. The author is of opinion that in the English works employing the Simon-Carvès oven, condensation is still imperfect, and the methods for most efficiently recovering tar and ammonia are not much beyond the stage of infancy, so that it is somewhat premature, as yet, to attempt to set bounds to the value of the Simon-Carvès ovens as producers of coal-tar and ammonia. With respect to the employment of very high temperatures in carbonising coal in closed vessels, it is interesting to find that practically the very highest temperatures that can be employed are the best for the production of benzene. The author regards the tar obtained at present in the works of the Bear Park Company as equal to the best Lancashire coal-tars. The proportion of tar obtained on the coal carbonised is also stated to be greater than that obtained elsewhere. One difference from ordinary gas-retort tar is observable even in the Bear Park product—viz., that the carbolic acid is less in amount in this latter tar, about 0·3 per cent. against about 0·5 per cent. as the lowest average from the ordinary gas-retort. The author thinks this less quantity of phenols is due to the fact that the tar vapours in the Simon-Carvès ovens have to pass through a very considerable mass of superincumbent coke at a very high temperature, and the rate of aspiration from the highly-heated atmosphere of the ovens is comparatively and of necessity very slow.

Referring to Schulze's theory, that the primary products of the dry distillation of coal are phenols (this Journal, vol. iv. 335), the author states that if this view be correct, and phenols are primarily formed on the distillation of coal, then with a lower distilling temperature we might expect to obtain tars richest in phenols, and at more elevated temperatures the phenols should diminish and hydrocarbons proportionately increase. This is so in the case of both Pease's and the Bear Park tars, but when a close distillation is carried on at low temperatures, with shales or cannel coal, as in the Scotch paraffin industry, tars are obtained which are rich in paraffin but poor in phenols. This circumstance does not seem at first sight to bear out Schulze's theory, unless it be considered that the points of temperature at which a maximum yield of phenols is obtained, and that at which they decompose to yield hydrocarbons, lie somewhat near together, and that the temperature employed in the distillations in the paraffin industry are in the main below those necessary to produce aromatic substances, and amongst them phenols.

The author has found the benzenes distilling constantly between 80° and 82°, and prepared from the tar from the Simon-Carvès coke-ovens, to be very rich in thiophen, by comparing the indophenin reaction obtained with such benzenes with the reaction obtained with benzenes of other origin, from which he concludes that a high temperature and exposure to prolonged contact with red-hot coke rather favours than otherwise the production of thiophen. By applying the indophenin reaction to the benzene obtained from light shale naphthas or spirit, no trace of thiophen was found to be present; this experiment would appear to show that the temperature of formation of thiophen lies higher than that necessary for the formation of benzene, and it is possible that a carbonising temperature might be adopted, at which benzenes are produced more or less free from the thiophens.

Since the reading of the author's paper before the Iron and Steel Institute, in Chester, in 1884, Maderspach and Siersch have adapted the Appolt coke-oven for the recovery of by-products. It is proposed to use a similar alternate regenerative heating arrangement to that adopted by Otto in the case of his coke-ovens. The author thinks that, as a whole, ovens with bottom flues, *as well as side flues, must work better.* The ovens patented by Maderspach and Siersch have side flues only. —D. B.

Recent Results and Further Development of the Simon-Carvès Coking Process (Utilisation of By-products). H. Simon. Jour. Iron and Steel Institute, 1885.

After referring to the progress made in the Simon-Carvès coking process during the twelve months which have elapsed since the last summer meeting of the Iron and Steel Institute, the author discusses the working and construction of the ovens. To give the best results these ovens must be driven at a temperature varying as little as possible. Variations of temperature affect the quality of coke and influence the wear and tear of the ovens. It is also of extreme importance to charge and draw the ovens regularly, as this is the only way of obtaining the maximum of good results, not only in quality and quantity of by-products, but also in obtaining these by the least expenditure of intelligent labour and of wages. The author then refers to the utilisation of by-products at the works of the Terrenoire Company, near St. Etienne, where the gas, after having undergone the usual treatment for the recovery of by-products, is, before being burned in the ovens, subjected to a further process for the extraction of benzene and other light hydrocarbons. (See this Journal, iv. [5], page 338.) —D. B.

Natural Gas Fuel, and its Application to Manufacturing Purposes. A. Carnegie. Journ. Iron and Steel Institute, 1885.

The author gives a detailed account of the four gas producing districts near Pittsburg. At the principal field, that of Murraysville, nine wells have been sunk yielding as much as 30,000,000 cubic feet of gas in 24 hours. The wells of Washington County are less productive than those of the Murraysville district, whilst the Butler gas fields and the wells of the Tarentum district supply a considerable portion of the gas used. The cost of piping is now estimated, at the present extremely low prices, with right of way at £1500 per mile, the cost of drilling being about £1000. The mode of procedure is described in detail in the original paper. The pressure of the gas as it issues from the mouth of the well is about 200 pounds per square inch. At the works where the gas is used, nine miles from the wells, the pressure is 75 pounds per square inch. Eleven lines of pipe convey gas from the various wells to the manufacturing establishments in and around Pittsburg.

ANALYSES OF NATURAL GAS.

No.	CO_2	CO	O	C_2H_4	C_2H_6	CH_4	H	N	Heat units.
1	0·80	1·00	1·10	0·70	3·60	72·18	20·02	—	728,746
2	0·60	0·80	0·80	0·80	5·50	65·25	26·16	—	698,852
3	—	0·58	0·78	0·98	7·92	60·70	29·03	—	627,170
4	0·40	0·40	0·80	0·60	12·30	49·58	35·92	—	745,813
5	—	1·00	2·10	0·80	5·20	57·85	9·64	23·41	592,380
6	0·30	0·60	1·20	0·60	4·80	75·16	14·45	2·89	745,591

ANALYSES OF SIEMENS' PRODUCER GAS.

No.	CO_2	CO	H	CH_4	N	Heat units.
1	3·90	27·30	—	1·40	67·40	93,966
2	8·60	20·00	8·70	1·20	61·40	97,184
3	9·30	16·50	8·60	2·70	62·90	99,074
4	1·50	23·60	6·00	3·00	65·90	114,939
5	6·10	22·30	28·70	1·00	41·90	164,164

The author has compared the heating power of natural gas with *bituminous coal, and found that* 54·4 pounds of coal slightly above the general average of Pittsburg coal are equal in heating power to 1000 cubic feet of gas, so that at a cost of five shillings per ton of coal (2000 pounds) 1000 cubic feet of gas are worth for their heat units 1·632 pence. In comparing this gas with anthracite coal, it was found that 1000 cubic feet of gas are equal to 58·4 pounds of coal. If this coal cost 26 shillings per ton, 1000 cubic feet of natural gas are worth nine and a-half pence for heating power.—D. B.

IV.—COLOURING MATTERS AND DYES.

Method for the Manufacture of Azo-colours. Verein Chemischer Fabriken, Mannheim. Ger. Pat. 29,957, February 19, 1884.

Two molecules of a phenol in an alkaline solution are acted upon with one molecule tetrazoditolyldisulphonic acid. In this manner yellow colouring matters are obtained from phenol, cresol, and xylenol. The naphthols and their sulphonic acids yield red colouring matters, of which those derived from β-naphthol are especially beautiful.—F. M.

Improvements in and relating to the Manufacture of Colouring Matters. William Robert Lake, Southampton Buildings. From Léo Vignon & Co., Lyons, France. Eng. Pat. 6872, April 26, 1884.

This invention relates to the production of azo-colours from α-naphtholdisulphonic acid, and the diazo-compounds of amines or their sulphonic acids. The α-naphtholdisulphonic acid is prepared by heating α-naphthol with three times its weight of mono-hydrated sulphuric acid to from 100 to 110° for 8 to 10 hours. A list of the colouring matters produced by the different diazo-compounds is given in the specification; these vary from orange-red to violet-red.—R. M.

Process for Separating the α-monosulpho Acid of the β-naphthol from certain Admixtures. Herbert John Haddan, 67, Strand, Westminster. From the Farbenfabriken vorm. Fr. Bayer & Co., of Elberfeld, Germany. Eng. Pat. 8495, May 31, 1884.

The object of this invention is to purify the sulphonic acid obtained by rapidly sulphonating β-naphthol at 50-60° from Schäffer's acid, "and another body which is probably also a monosulpho acid of the β-naphthol." The method of separation depends upon the facility with which tetrazodiphenyl and its homologues combine, first with the "foreign body," then with Schüffer's acid, and lastly with the β-naphthol-α-sulphonic acid. The latter, which is the most valuable product, is required for the crocein scarlet, and by fractional precipitation with tetrazodiphenyl, the "foreign body" and Schäffer's acid are first removed. The advantages claimed for this process are that the by-products which are first precipitated are economically valuable, being valuable claret-red dyes.—R. M.

Improvements in the Process of Manufacturing Chloro-iodic Bases and Colouring Matters. Eugen Ostermayer, Würtemberg; and Max Dittmar, Königsberg. Eng. Pat. 9252, June 20, 1884.

THE bases of the pyridine and quinoline series, when treated in hydrochloric acid solution with iodochloric hydrochloride, form crystalline compounds. In the case of quinoline the substance has the formula C_9H_7NICl. When the neutral aqueous solution is boiled the compound gives off iodine. The following illustrations of the process are given:—(1) 5kilos. of iodine are suspended in 20kilos. of water, and chlorine is introduced till the iodine is dissolved. The solution of $IClHCl$ is then mixed with a hydrochloric acid solution of 5·2kilos. of quinoline, and the orange-yellow precipitate filtered, washed with water till of a bright sulphur yellow, and then pressed. (2) 5kilos. of KI are dissolved in 5kilos. of water, and 25kilos. HCl added; 4·8kilos. of sodium nitrite are gradually added till a clear solution is formed, when the latter is mixed with 3·85kilos. of quinoline in hydrochloric acid as before. Instead of quinoline and pyridine, their homologues may be employed (toluquinoline, quinaldine, toluquinaldine, etc.), and also the chloromethylates. Examples are given showing the process employed in the case of quinoline-chlormethylate, tetrahydroquinoline-chlormethylate and oxyquinoline-chlormethylate. When these chloriodised bases are heated with aromatic amines (equal molecules of each), red, violet, and blue colouring matters are produced. Thus, with dimethylaniline a blue violet colour is formed. By the addition of benzyl chloride during the reaction the colour obtained is greenish blue.—R. M.

Improvements in the Production of Colouring Matters suitable for Dyeing and Printing. John Erskine, Glasgow. From the Farbenfabriken vormals Friedrich Bayer & Co., Elberfeld. Eng. Pat. 9518, June 28, 1884.

THE new colouring matter described in this specification is a secondary azo compound resulting from the combination of diazoxylene-azobenzenesulphonic acid with β-naphthol-α-sulphonic acid. The formula of the compound is:—

$$SO_3NH_4.\underset{(1)}{C_6}H_4.\underset{(4)}{N}:N.C_8H_8.N:N.C_{10}H_5.\underset{(\beta)}{HO}.\underset{(\alpha)}{NaSO_3}$$

The solution of the diazo-azo compound is mixed with the well-cooled solution of the naphthol sodium salt in the presence of ammonia and the colouring matter salted out.—R. M.

Improvements in the Manufacture of Dye-wood Extracts, etc. Harold Rimmer, Liverpool. Eng. Pat. 9570, June 30, 1884.

THE liquors are concentrated by heat nearly to 10° Tw., reducing the temperature to 80-90° C., and then completing evaporation by the application of air, which is forced through the liquid until the desired strength is attained. For the latter purpose perforated pipes or a rose may be used and supplied by any suitable blowing mechanism or exhauster. "The strength of 10° Tw. can be obtained without discolouring the liquid, but if a temperature of above 80° C. or 90° C. be used for higher concentration, the liquor is liable to be discoloured or 'burnt.'" "By this invention the liquor can be brought to a greater density than can be accomplished by the vacuum process, and the liquor can be concentrated at a higher temperature without the danger of discolouring than by the ordinary open process."—H. A. R.

Improvements in the Manufacture of Dyes or Colouring Stuffs. Emil Capitaine, 89, Chancery Lane, Middlesex. From Adolf Ewer and Paul Pick, of Berlin, Germany. Eng. Pat. 9632, July 1, 1884.

THE object of this invention is to prepare colouring matters varying from yellow to brown by acting with cyanic acid and its derivatives upon primary, secondary, or tertiary amines, or tetra-alkylised derivatives of diamidobenzophenone in the presence of condensing agents. Of the derivatives of cyanic acid the authors specify the ethers, the polymerides and their ethers, the derivatives of urea, and the sulpho-derivatives of cyanic, isocyanic, and cyanuric acids, and the sulpho-derivatives of urea. The condensing agents mentioned are potassium pyrosulphate, meta- and pyrophosphates, phosphorus trichloride, pentachloride and oxychloride, the chlorides and fluorides of boron and silicon, and the chlorides of zinc, magnesium, calcium, and aluminium. Of the colouring matters producible by these reactions the inventors claim only those which, by the action of strong mineral acids, split up into ammonia or a primary aromatic amine, and a tri-, di-, mono-, or non-alkylised diamidobenzophenone. Examples illustrative of the mode of working are given in the specification.—R. M.

Improvements in Producing Sulpho-colouring Matters by Electrolysis. Emil Capitaine, 89, Chancery Lane, Middlesex. From Messrs. Ewer and Pick, Berlin, Germany. Eng. Pat. 9756, July 4, 1884.

THIS invention is based upon the observation that when two plates of platinum are immersed in a solution of paramidodimethylaniline in dilute sulphuric acid, and the solution saturated with sulphureted hydrogen, the liquid round one of the platinum plates assumes a blue colour when this plate is made the positive and the other plate the negative pole of a voltaic battery or a dynamo-machine. The blue colour formed round the positive plate soon disappears and a grey film collects on the plate; when this film is brushed off the blue colour is again developed, so that if the positive plate is kept clean by constant brushing, the blue colour formed does not disappear, and the colour of the solution becomes deeper as the electrolytic operation proceeds owing to the conversion of the "methylene white" into "methylene blue." In illustration of the mode of working, the inventors describe and figure a form of apparatus which consists of a wooden vat varnished inside, and containing an insulated wooden shaft provided with arms for stirring the liquid, and also with a set of arms provided on their opposite faces with bristles for cleaning the electrodes. The latter are platinised copper plates fixed horizontally in the vat at such a height that they are swept by the brushes on the revolving shaft. A solution of 1 part of paramidodimethylaniline in 40 parts of water and 4 parts of sulphuric acid of 66° B., is first run into the vat, and the stirring apparatus and the electric current started. A solution of sodium sulphide is then run in till the vat liquor is saturated with SH_2. From time to time the liquor is tested for paramidodimethylaniline, and when the substance is no longer present the supply of sodium sulphide is stopped, the excess of SH_2 removed by blowing air through the solution, and the electric current continued till all the "methylene white" has become converted into "methylene blue." The latter is then precipitated by zinc chloride and common salt in the usual way. The process is applicable to other alkylised derivatives of para-diamines, and also to the production of methylene blue directly from nitrosodimethylaniline by first reducing this substance at the negative electrode and then proceeding as before. A form of apparatus for working this last process continuously is described (see this Journal, iv. [5], 310).
—R. M.

Improvements in the Manufacture of Colouring Matter. William Robert Lake, Southampton Buildings, London. From Léo Vignon & Co., Lyons, France. Eng. Pat. 9808, July 5, 1884.

THIS invention relates to the preparation of a yellow colouring matter by nitrating α-naphtholdisulphonic acid. The latter is prepared by heating 30 parts α-naphthol with 180 parts of sulphuric acid of 66° B. to from 80-100° C. for 8-10 hours. The product is mixed with ice and the diluted solution nitrated by gradually adding 90 parts of nitric acid of 40° B., not allowing the temperature to exceed 30° C. The temperature is afterwards raised to 40° for a few minutes, and then reduced to from 12-15° C., and the precipitate collected, pressed, and converted into a potassium salt. The original feature of the invention is stated to be the employment of the sulphuric acid of 66° B. instead of fuming sulphuric acid. —R. M.

Improvements in the Manufacture of Colouring Matters. William Robert Lake, Southampton Buildings, London. From Léo Vignon & Co., Lyons, France. Eng. Pat. 9812, July 5, 1884.

THE object of this invention is to prepare a series of blue and violet colouring matters containing sulphur from paradiamines produced by the reduction of amidoazo compounds. The process consists of three operations:—(1) The formation of paradiamines by the reduction of the amidoazo compounds by means of sodium sulphide or other reducing agents; (2) The conversion of the paradiamine into a thio-base in the wet way by the prolonged action of sulphuretted hydrogen, or in the dry way by fusion with sulphur according to Lauth's method; (3) The oxidation of the thio-base by means of ferric chloride, potassium bichromate, etc. Amidoazobenzene gives a blue, amidoazotoluene a violet dye, by these operations. The colours are said to be easily applicable to mordanted cotton and to be fast both to light and soap.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

An Improved Substitute for Gut, applicable to Lawn Tennis and other Rackets; also suitable for Clocks and other Mechanical Purposes. Robert Müller. Eng. Pat. 6446, April 17, 1884.

THE inventor prepares artificial gut by dipping twisted silk cords in a mixture of gelatin and glycerin, the latter being added to give pliability. From 8 to 10 parts of glycerin to 100 parts of gelatin forms a good average mixture. It should be applied at a temperature of 70° C.—E. J. B.

Improvements in the Manufacture of a Combined Paper and Cloth Material for Bookbinding, etc. S. Barlow, Castleton, Manchester. Eng. Pat. 9727, June 3, 1884.

INVENTOR passes the two materials, cloth and paper, through a pair of bowls, one of which has a rigid surface and the other a resilient one. The cloth may be previously stiffened by an ordinary mangle or back-starcher. The adhesive substance used to unite the two materials may be starch, gum, or any other convenient substance. Inventor claims that previous attempts to combine cloth and paper in this manner have been failures, owing to the use of rollers or bowls entirely with rigid surfaces. For rigid bowls he employs brass, copper, hard wood, iron or steel. For the resilient rollers either indiarubber, or metal coated with indiarubber, gutta-percha, cotton, or paper, is employed. The combined material is dried by passing over the steam cylinder as usual, or by any convenient drying process, and may then be calendered, embossed, or finished in any way required.—H. A. R.

Improvements in the Method of and Apparatus for Carbonising and Drying Woollen Pieces, Wool Noils, Waste or Rags. Duke Fox. Eng. Pat. 9273, June 21, 1884.

AN apparatus is employed for treating woollen materials from which it is desired to remove vegetable matter with hot hydrochloric acid gas. The patentee claims "wool or rag carbonisers constructed with a central chamber connected with retorts, the chamber is fitted with a series of swing grids arranged for lowering the material to be operated upon from one grid to another." The specification is accompanied by drawings illustrating the construction of the apparatus.—E. J. B.

An Improved Method or Process of Destroying Vegetable Substances contained in Wool or Woollen Fabrics. George Sales Jarmain. Eng. Pat. 9373, June 24, 1884.

THIS process consists in heating wool or woollen fabrics in a bath of dilute hydrochloric acid. After washing and drying, the material can be readily freed from vegetable matter by mechanical means. The strength of acid and duration of treatment can be varied according to circumstances. With an acid of 1½° Tw., and a temperature of 200° F., about 105 minutes' immersion will suffice at 8° Tw. and a temperature of 180° F.; the treatment should be continued for twenty-six minutes. If the temperature be allowed to rise above 200° F., the woollen material is liable to be affected.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

On Printing with Artificial Indigo. H. A. Costobadie Bull. Soc. Ind. Rouen, 1884, 757.

ORTHONITROPHENYLPROPIOLIC acid, which at the time of its appearance attracted a great deal of attention, has now almost fallen into oblivion, most printers having given up using it on account of its high price. Yet, the artificial indigo produced from it possesses certain advantages over the natural product, and for this reason some printers are still using it, especially for light shades. In this case the high price does not form such a great drawback to its application. The treatment of the printed cloth is very simple. It is hung up at a temperature of 25° C. for twelve hours until the blue is fully developed, then soaped at 75° C. and steamed in a Mather & Platt's apparatus. By the process of steaming the disagreeable odour adhering to the cloth (derived from a decomposition product of the xanthate used as a reducing agent) is completely removed. Propiolic acid is also suitable for producing even sky-blue shades by the patting process, upon which discharge patterns can be obtained in the same manner as on vat-blue. Also resist patterns not readily obtainable with natural indigo can be produced with propiolic acid in the manner below described. The mordants thickened with British gum are first printed on the cloth and then dyed up in a colour bath. In order to produce white resist patterns on a blue ground, a mixture containing citric and oxalic acids, and consisting of 96 litres lemon juice 28° B., 24 litres caustic soda 36°, 2 litres oil or tallow, 36kilos. dextrin, and 1·2kilo. oxalic acid, are printed on. After ageing, the cloth is padded with propiolic acid, hung up for twelve hours for the purpose of developing the blue, and passed once more through this process. The standard colour mixture is composed of 3·6kilos. starch, 36 litres water, 31·6kilos. 20 per cent. propiolic acid paste, and 5·5kilos. borax. A printing colour is prepared by adding to 5 litres of this mixture 500 grammes sodium xanthate, a padding colour by mixing 4 litres of this printing mixture with 12 litres of starch paste. The development of the blue being completed, the pieces are passed through a bath of sodium arseniate at 75° C., and then through the colour bath, the temperature of which should be kept as low as possible to avoid deterioration of the blue colour. The pieces are finally soaped at a temperature below 75° C. A resist for chrome yellow and orange is obtained by adding to these colours oxalic acid in the proportion of 15 grammes per litre. Fine orange shades might also be obtained by dyeing up the resist mordant in a nitroalizarin bath. Catechu brown is turned much darker through the influence of the padding colour, this phenomenon being probably due to a peculiar action of the soda xanthate.—F. M.

Effects produced by the Sulphurous Acid of the Atmosphere of Towns. G. Witz. Bull. Soc. Ind. Rouen, **13**, 161.

The author has proved the prevalence of sulphurous anhydride in the atmosphere of the town of Rouen by observations on certain bills printed with lead pigments, chiefly minium, and posted on walls of various aspects. Certain of these which were observed to fade very rapidly were examined, and found to contain both sulphate and sulphite of lead. Bills of the same kind posted along the country roads, although more exposed to the weather, showed a decreasing decolorisation of the printed matter in proportion to the distance from the town. It was also observed that notices printed in the same pigments, and exposed in shop windows where gas was burnt, showed a similar decolorisation, and the presence of sulphite of lead was similarly established. The presence of sulphurous acid in an atmosphere may be readily demonstrated by introducing a glass vessel filled with ice; the humidity condensed on its surface may be tested by the ordinary reagents for this compound. More simply still, the moisture condensed on the windows of a room when gas is being burned will be found to decolourise iodide of starch. The condensation of sulphurous acid together with the moisture in fogs and hoar frosts has been found by the author seriously to affect goods printed with colours sensitive to sulphurous acid; of these he specifies logwood and Brazil wood shades, and aniline black (compare *Ibid.* 1879, 185; 1877, 263; 1876, 310; and 1873, 76). The author especially commends these results and his method of observation to the notice of dyers and calico printers.—C. F. C.

An Improved Apparatus and Process for Bleaching, etc., Fibrous Materials. W. D. Gedge, London. From C. F. Glaser, Berlin. Eng. Pat. 7900, March 19, 1884.

The chief point of this invention is the placing in the interior of the boiling kiers, fitted as required and usual, one or more proportionately light and easily removable vessels, with perforated bottoms, which are charged with the goods to be acted upon; and the arrangement of the space between the inner and outer vessels, by partitions, in such a manner that the agents which are introduced or made to circulate in the boiler may be forced to pass through the materials to be acted upon, and that however high the pressure may be during the operation, the strain on the inner vessel may never exceed that which is necessary for the penetration of the goods.

—H. A. R.

Improvements in Washing and Dyeing Machinery. J. Worrall, Salford. Eng. Pat. 7709, May 14, 1884.

The main feature of this invention is in a washing and dyeing machine, the combination of a tank for containing liquor, with a frame carrying a ring of guide rollers, and two rings of winches or beaters concentric with the rollers, the guide rollers serving to present the fabric, as it is drawn through the machine, to the action of the beaters, such beaters being driven by gearing operated from the central shaft, and serving, while the cloth is presented to the action of the liquor, to impart to the cloth a rapid vibratory motion.—H. A. R.

Improved Apparatus to be used in Bleaching and Dyeing Piece Goods. J. Worrall, Salford. Eng. Pat. 9582, June 30, 1884.

In treating velvets, velveteens and similar goods, great difficulty has hitherto been found in preventing the formation of creases in the goods, which creases are due to the curling up of the selvedges as the fabric is travelling through the bleaching, washing or dye vat. In order to counteract the said curling up, the inventor passes the cloth, during the time of its being acted on by various agents, round a drum surrounded by eight or twelve pressing cylinders, there being fitted between these cylinders, except at the part where the cloth enters and leaves the apparatus, guide bars, tubes or rollers, for holding the cloth away from the drum while it is receiving a supply of bleaching or dyeing liquor. The supply is delivered to the cloth through some or all of the guide bars or tubes, which are slotted for that purpose, and are in communication with a supply cistern or pump. The guide bars, or every alternate one, will be furnished with diagonal ribs, inclining towards a central line, and serving to put a slight lateral strain on the cloth as it passes over the bars, so as to keep the selvedges well extended. For drawings and details the original specification should be consulted.—H. A. R.

Printing one or more Colours simultaneously on Cotton or Woollen Hanks and the like. T. G. Charlesworth, Leicester. Eng. Pat. 9614, July 1, 1884.

The inventor claims the method of dyeing or printing hanks by a sideway passage through the rolls. The method of printing two or more colours simultaneously by a sideway passage through rolls divided into sections, one for each colour, and corresponding divisions in the colour trough, one for each colour, the combination with the colouring rolls of a hank-feeding device consisting of an endless travelling chain with hooks, upon which the hanks are hung. The rolls are covered with felt, rubber, or some similar soft absorbent substance; and one passage through the rolls completes the printing, after which the hanks are dried as usual.—H. A. R.

A New Mode of Dyeing Cotton and other Vegetable Fibres with Insoluble Azo-colouring Matters. Dan Dawson, Huddersfield. Eng. Pat. 9701, July 3, 1884.

The inventor claims that by bringing about a slow and gradual combination of materials used to produce the colour, aided by the "catalytic" action of the cotton when immersed in the bath, the dyeing can be done at one operation. It is proposed to accomplish this by keeping the bath free from mineral acid, and only having a small quantity of a weak organic acid present—*e.g.*, acetic acid. The bath is prepared as follows: A body—*e.g.*, naphthylamine—is diazotised as usual. Strength of solution to be about one per cent. of chloride, and plenty of HCl required present. The bath is neutralised by means of chalk. Then are added finely-precipitated naphthol and acetate of soda, with a little acetic acid. It is claimed that cotton immersed in the above bath will fix the colouring matter as it forms. The fixing of an insoluble soap before dyeing causes the operation to take place more quickly, and deeper shades to be obtaued.—H. A. R.

A New or Improved Bleaching Solution. R. B. Lyth, Belfast. Eng. Pat. 9802, July 5, 1884.

The inventor prepares a bleaching solution by charging a solution of chloride of lime with sufficient carbonated water to precipitate the lime held in solution. It is claimed that a much shorter time is required for bleaching the goods, that less boiling is required, that the application is much safer and turns out the goods stronger, and also that it is cheaper than any other process hitherto applied.—H. A. R.

An Improved Process in Dyeing with Substances containing Tannin, or Tannic Acid, or Gallo-tannic Acid. Henry Grandage and Robert E. Steel, Bradford, Yorkshire. Eng. Pat. 12,490, September 12, 1884.

The invention consists in an improved process of dyeing fibres where tannin or tannic acid is employed, and has for its object the union with the fibre of a larger quantity of tannin or tannic acid from a given solution than can be united by processes at present in use in dyeing. To obtain this result it is proposed to add to the solution containing the tannin itself obtained from myrabolans, sumac, divi-divi, galls, gambier, etc., before employing it for dyeing, one or more of the following salts—viz., sodium chlorate or biborate, potassium chloride, or ammonium chloride. The quantities of the above salts found to give the best results were found to be sodium chloride 10 per cent., borax ½ per cent., potassium chloride 10 per cent., ammonium chloride 2 per cent. The percentages are calculated on the crude tannins from which the solutions are made. Inventors do not claim as original any process for extracting tannin, but claim as novel and original the adding of certain salts to the tannin solutions in order to cause fibres to assimilate more tannin.—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

New Chemical Apparatus for the Recovery of Nitrous Compounds in the Manufacture of Sulphuric Acid. Dingl. Polyt. J. **256**, 125.

For the recovery of the nitrous compounds in the manufacture of sulphuric acid, the Société Anonyme des Produits Chimiques de la Manufacture de Javel, Paris, proposes (Ger. Pat. 30,749, August 12, 1884) to wash the gases previous to their passage into the Gay-Lussac apparatus with a spray of concentrated sulphuric acid, the latter being only intended for retaining those nitrous compounds which have been carried away mechanically. The lead-lined tower A (Figs. 1 and 2) contains a small quantity of coke C upon a grid fixed at a height of about one metre above the bottom, and serving for the distribution of the gases entering by the pipe B. A fine rain of sulphuric acid of 60-62° B. falls from the acid distributors *x*. The construction of one of these distributors working under the pressure of a column of liquid in the pipe E, three to four metres high, will be understood from the wood-cut (Fig. 3). The small spreading disc *a* is fixed to one end of the rod *b*, which passes through the vessel D and is surrounded by the pipe F. The other end of the rod is furnished with a thread, and by means of the nut *d* fixed upon D. In accordance with the more or less cone-shaped form of *a*, the liquid which passes through the annular opening of the vessel D falls in a rain of greater or smaller radius.—F. M.

Fig 1

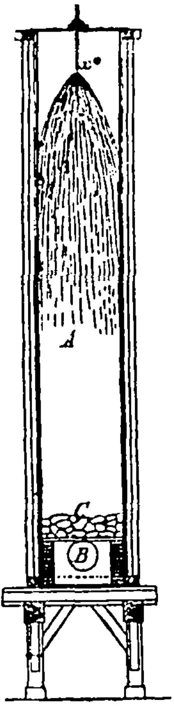


Fig 3.

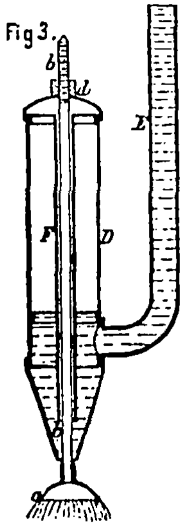
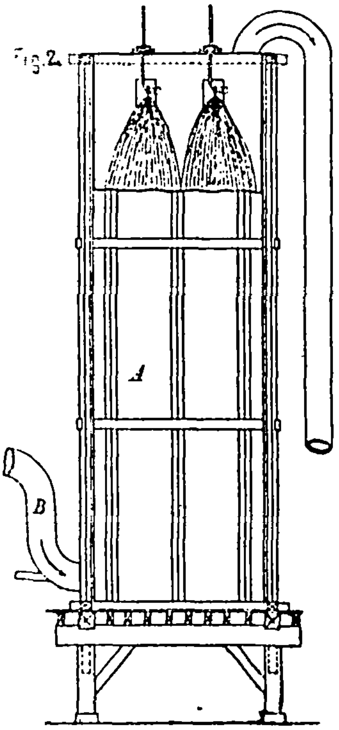


Fig. 2.



Process for Decomposing the Chlorides and Oxychlorides of Magnesium, Manganese and Chromium. Dingl. Polyt. J. **256**, 125.

For the purpose of decomposing the chlorides and oxychlorides of magnesium, manganese, and chromium, the concentrated solutions of these salts, according to a patent of R. Nithack, Nordhausen (Ger. Pat. May 29, 1884), are in a fine state of division brought into contact with hot bodies. The pipe R (Fig. 4) is connected with the flue F, and serves as a super-heater. A spray producer Z connected with the pressure vessel containing the salt solution is fixed in the wall of the long narrow chamber C. The latter and the larger chamber K, in

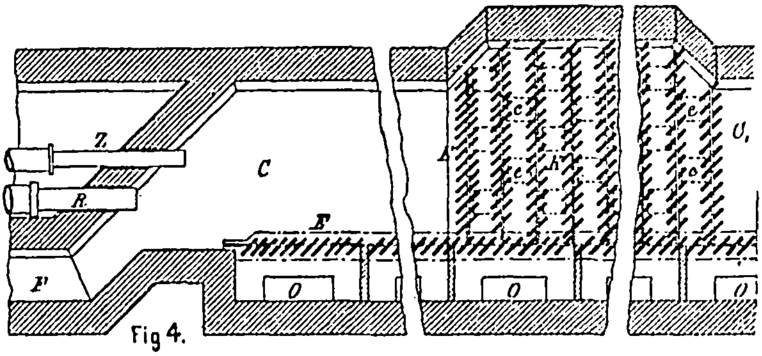


Fig 4.

which rows of fire-clay tiles are set up, are furnished with a kind of false bottom, likewise consisting of slanting tiles, through which the solid masses fall, and can be removed through the openings O or c. The plates E are either fixed or arranged so that the distance between them is adjustable. From the chamber K, the flue C_1 leads into another chamber, and so forth; the gases pass at last through a system of regenerators into the condensers. The method of working this apparatus consists in first heating up the flues and chambers, and then blowing in the solution through the nozzle connected with the spray producer Z. The fine particles of the salt solution coming in contact with the hot air from F and the walls of the chambers are decomposed according to the equations $MgCl_2 + H_2O = MgO + 2HCl$; $2HCl + O = Cl_2 + H_2O$, etc.—F. M.

On the Composition of the Gases produced by the Combustion of Iron Pyrites. M. Scheurer-Kestner. Bull. Soc. Chim. 1885, xliii. p. 9.

The author has made thirteen more analyses of the gas from Maletra burners. In only one case was sulphuric acid absent. The rest gave results ranging from 0·4 to 9·3 SO_3 per 100 parts of SO_2. There appears to be no connection between the percentages of sulphuric and sulphurous acids present in the burner gases. The acid liquors condensing in the connections leading from the burners generally have a sp. gr. of from 1·6 to 1·689. The author explains the absence of anhydride as such by showing that the moisture in the pyrites and the air consumed, is more than sufficient to hydrate the whole of the sulphuric anhydride formed. The bulk of this anhydride (consequently as sulphuric acid) he supposes is condensed in the Glover tower, which coincides with the fact that the acid used here is observed to increase in its passage from the top to the bottom. It is true Mr. Forster, eleven years ago, gave it as his opinion that this increase was entirely due to the oxidation of sulphurous acid by the nitrous acid from the Gay-Lussac; but as Mr. Forster's burner gases seem to have contained no sulphuric anhydride, and as his Glover tower was of a very low concentrating power, the author cannot regard this as a refutation of his opinion, the more especially as Mr. Forster's own calculations show a deficiency of sulphurous acid *leaving* the Glover; and the manner in which his experiments were made leaves it open to question whether this deficiency was not even greater than stated. Experiments extending over sixteen days showed that from fifteen to twenty per cent. of the total acid produced were condensed in the Glover tower. This may be supposed to include both the sulphuric anhydride proved by the author to exist in the burner gases, and the sulphuric acid formed in the Glover itself by the action of the nitrogen compounds upon the sulphurous gas, as stated by Mr. Forster.—A. R. D.

Improvements in Apparatus to be employed in the Production of Carbonate and Bicarbonate of Soda from Sulphate of Soda, or from Chloride of Sodium. Holbrook Gaskell and Ferdinand Hurter. Eng. Pat. 8804, June 10, 1884.

This apparatus consists of arrangements for preparing solutions of sodium sulphate, and of apparatus for saturating such solutions with ammonia and carbonic acid gas—viz., a series of cylinders, through which the ammoniacal solution of sodium sulphate and carbonic acid gas under pressure, flow in opposite directions. —F. H.

Improvements in the Manufacture of Chlorine. Thomas Macfarlane. Eng. Pat. 9234, June 20, 1884.

Dry manganese protochloride, obtained by evaporation of residual solutions of the manufacture of chlorine, is ground and mixed with from one to four times its weight of dry ferric oxide. The mixture is heated in a muffle furnace to about 400° C., and dry air passed over it. The air is dried by means of calcium chloride. The manganous chloride is decomposed, manganese sesqui and dioxide are formed, and chlorine gas evolved. The chlorine diluted by nitrogen, and containing some hydrochloric acid, is cooled, washed and absorbed by lime to produce bleaching powder. The mixture of manganic oxides and ferric oxide is treated with hydrochloric acid, which attacks the manganic oxides, whereby chlorine is liberated, while the ferric oxide remains for the most part unchanged. The mixture of solution of manganous chloride with ferric oxide is evaporated to dryness, and the dry residue is heated as above described. This round of operations may be continued indefinitely.—F. H.

Improvements in obtaining partly in the Free State and partly as Vapour of Hydrochloric Acid, the Chlorine of the Chloride of Magnesium of Aqueous Solutions of Chloride of Magnesium, or of Mixed Solutions of Chloride of Magnesium and Chloride of Sodium. Walter Weldon. Partly from A. R. Pechiney & Co., Salindres. Eng. Pat. 9306, June 23, 1884.

Solutions of magnesium chloride, which may contain sodium chloride (such as are obtained by decomposing by magnesia the ammonium chloride contained in certain residual solutions of the manufacture of soda by the ammonia process), are concentrated by evaporation as far as can be done without evolution of hydrochloric acid. Sodium chloride salts out, and is removed by fishing. To the boiling concentrated solution of magnesium chloride is added, and intimately mixed therewith, from one-half to one and one-half equivalents of magnesia, such as results from a subsequent operation. A solid hydrated magnesium oxychloride is thus obtained. This oxychloride is first desiccated at a comparatively low temperature (150° to 300° C.). The water, together with a small quantity of hydrochloric acid, are driven off. The desiccated oxychloride is then further heated in contact with a current of air (preferably in apparatus as described in Eng. Pat. 9304, 1884). The chlorine of the oxychloride is thereby driven off, partly as free chlorine, partly as hydrochloric acid. The latter is condensed, and the chlorine then utilised. The resulting magnesia is used in part as above described.—F. H.

Improvements in the Manufacture of Chlorine and Hydrochloric Acid. Walter Weldon. From A. R. Pechiney & Co., Salindres, France. Eng. Pat. 9307, June 23, 1884.

Magnesium chloride containing water is first heated in vessels resembling retorts or muffle furnaces, with little or no access of air, to a temperature at which the water reacts upon the magnesium chloride, yielding magnesia and hydrochloric acid, which is condensed. The resulting mixture of magnesium chloride and magnesia is then heated in a current of air. The chlorine contained in the solid residue of the first operation is thus driven off, partly as hydrochloric acid, but largely as free chlorine. The two operations may be carried out in two distinct pieces of apparatus, or in one single apparatus, for which that described in Eng. Pat. 9304, 1884, is recommended. —F. H.

Improvements in the Manufacture of Sulphite of Soda. Eustace Carey and Holbrook Gaskell the younger. Eng. Pat. 9458, June 26, 1884.

Monohydrated sodium carbonate, either pure or in the crude state (salts), according to the desired purity of the product, is exposed to the action of sulphurous anhydride so long until sufficient sulphurous anhydride is absorbed to correspond to a neutral sulphite. The product contains sodium bicarbonate. The monohydrated sodium carbonate is exposed in revolving cylinders, through the hollow axles of which the sulphurous anhydride enters, and the carbonic acid together with inert gases leave. Several cylinders are employed in series if the sulphurous anhydride is obtained by combustion in air of brimstone or pyrites. If wet, the sulphurous anhydride must be dried by means of sulphuric acid.—F. H.

Improvements in the Manufacture of Chlorine and Hydrochloric Acid from Chloride of Magnesium. Walter Weldon. From Pechiney & Co., Salindres. Eng. Pat. 9688, July 2, 1884.

SOLID hydrated magnesium chloride, whether crystallised or not, is first heated to a temperature of from 150° to 200° C. By this operation the water can be reduced to about two equivalents, without the evolution of more than a very small proportion of the chlorine (chiefly in form of hydrochloric acid). The partially dehydrated magnesium chloride is then heated to a higher temperature in contact with air. Vapour of hydrochloric acid and free chlorine is evolved; but the latter in much greater proportion than would have been the case if the previous dehydration at lower temperatures had been omitted. The dehydration is carried out by passing over the solid hydrated magnesium chloride air or gases previously heated to the requisite temperature. The dehydrated magnesium chloride is heated in muffle furnaces, or in apparatus described in Eng. Pat. 9304, June 23, 1884.—F. H.

Method for the Manufacture of Sulphur from Sulphuretted Hydrogen. Oesterreichische Soda-Fabrik, Hruschau. Ger. Pat. 30,746, July 26, 1884.

THE sulphuretted hydrogen is passed over heated sulphates of alkalis or alkaline earths, whereby the oxygen of these salts decomposes the sulphuretted hydrogen, a sulphide and free sulphur being formed. By the action of atmospheric air upon the sulphide, sulphate is regenerated, which may again be used in the process.—F. M.

Improvements in the Methods of obtaining Ammonia and Hydrochloric Acid in the Manufacture of Soda from Sodium Chloride by the Ammonia Process. A. M'Dougall, Penrith. Eng. Pat. 2048, Feb. 10, 1885.

THIS invention consists of the substitution of magnesia for lime in the decomposition of the ammonium-chloride formed in the ammonia-soda process. Rather more than an equivalent of magnesia is added to the ammonium chloride in a suitable still, and heat applied till all the ammonia is liberated. A further heat, aided towards the end of the operation by stirring, and the introduction of a steam jet, now drives off the hydrochloric acid, which may be recovered in any suitable way, while the magnesia is left ready to be used over again.—A. R. D.

An Improved Method of treating Ammonium-chloride. W. P. Cochrane, Redcar; and W. Bramley, Middlesbro'. Eng. Pat. 11,222, March 14, 1885.

FROM the residual liquors of the ammonia-soda process, the small proportion of sodium chloride present is eliminated by "fishing." To the remaining solution of ammonium chloride magnesia is added in the proportion of rather more than two molecules for every two molecules of ammonium chloride present. On the application of heat the ammonia is readily liberated, especially if the mixture be stirred and kept at the consistency of milk of lime. The residual liquor contains magnesium oxychloride, which may be recovered by evaporation and used for the production of free chlorine, hydrochloric acid, and magnesia.—A. R. D.

Improvements in the Manufacture of Salt, and an Improved System and Apparatus employed therein. J. E. Higgin and T. H. Higgin, Liverpool. Eng. Pat. 9179, March 16, 1885.

THE evaporating pan is supported on pillars, and the space beneath it is enclosed with brickwork sides and ends. The floor slopes upwards towards the back. In front is a row of fireplaces with tightly-fitting doors, and provided, instead of firebars, with perforated iron plates—the holes being $\frac{3}{8}$ of an inch in diameter. Extending the length of the fireplaces is an air main having a branch delivering beneath the fire-bearing plates of each fireplace. Air in quantity more than sufficient for the combustion of the fuel is blown or injected through the main into the fireplaces, and so passes along the enclosed space under the pan. After it emerges from the other end of this it is caused to circulate through an air-heater consisting of a series of pipes through which the fresh supply of air needed by the process is drawn by the blower. The advantages claimed are economy in fuel, and a superior quality of salt, with fewer impurities.
—A. R. D.

Improvements in Apparatus for the Manufacture of Vinegar. W. H. Perry and J. O. Boulton, both of Nottingham. Eng. Pat. 9997, April 8, 1885.

THIS invention refers to apparatus in which the wash or liquid from which the vinegar is made is passed over beech or other wood shavings in presence of a current of air. Three casks are set at different heights, one above the other. The middle one, called the acetifier, is larger than the others, and has a false bottom of perforated wood or of wickerwork. On this false bottom are piled wood shavings to a suitable height. Above these is fitted a false top forming a kind of shallow well with the sides of the cask. This false top is drilled with small holes so that the liquor it contains may be well distributed over the shavings. Air-holes between the true and false bottoms, and higher up in the sides of the cask, provide for a constant current of air. The topmost cask supplies the liquor to the acetifier. A pipe from its lower portion dips into the shallow well above described, while another pipe from its top does the same, but does not go quite so deep. This latter is an air-pipe, and regulates the flow from the former. If its end is sealed in the well, the supply-pipe ceases to deliver; if, however, this end is unsealed, the supply-pipe delivers till it is sealed again, and so a constant depth of liquor is maintained in the well. The lowest cask is simply a receiver. It may be made interchangeable with the supply cask.—A. R. D.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, CEMENTS.

Improvements in Coating or Surfacing Bricks and Tiles. H. M. Smith, London. Eng. Pat. 9887, July 8, 1884.

THIS invention has for its object the application of a vitreous face or coating to an ordinary brick or tile. The brick in the green state is dipped in a "slip" of the vitreous material, or such faces as it is desired to treat are similarly treated, and the whole is fired in the usual manner. Another manner of securing the object of the invention is to apply the coating in the mould in which the brick or tile is pressed. The vitrified faces may or may not be glazed in the usual manner after the process of vitrification. The claim is for the process as described.
—C. C. H.

Improvements in Colouring Stones for Buildings and other Purposes. L. E. A. E. D. De-Liebhaber, London. Eng. Pat. 9888, July 8, 1884.

THE object of this invention is to change the colour of the stones used in building without the introduction of any fresh colouring matter, and particularly to impart a red or brown colour. The stone of the ordinary description used in building, such as Bath stone, etc., is heated to, or above, the temperature of melting lead, and this can be conveniently carried into effect by immersing the stone in a bath of melted lead, the melting point of which can be lowered or raised by the introduction of tin or zinc.—C. C. H.

Improvements in the Means of accelerating the Setting and Hardening of Cements. W. Millar and C. F. Nichols, London. Eng. Pat. 2886, March 4, 1885.

IN place of the water usually mixed with cements or concretes to render them plastic, the inventors add aqueous solutions of certain chemicals, which have the effect of (1) accelerating the setting properties of cement; (2) indurating it, or increasing its natural hardening properties; "and (3) acting upon the cement or concrete, when set, in such a manner as to enable the mass to be handled in from one hour upwards." The ingredients used for accelerating the setting of cements are sodium carbonate, alum and ammonium carbonate; for indurating or increasing the hardening properties of cements, calcium chloride, magnesia and magnesium chloride; and for obtaining an intense hardness, magnesium oxychloride. As an after process for further indurating cements, "silicon, boron, or some combination of these two chemicals with bichromate of potash" may be used.—E. G. C.

X.—METALLURGY, MINING, Etc.

Treatment of Slag and Phosphates. A. Frank, Charlottenburg, Prussia. Eng. Pat. 7059, April 30, 1884.

Molten liquid slag, or finely-divided solid slag, is treated with magnesium chloride solution, by which the sulphides are decomposed, hydrogen sulphide being produced; also free lime, if present, forms calcium chloride and magnesia, and thus indirectly produces a concentration and greater solubility of the phosphates contained in the slag. The powdery slag, with the adhering magnesium chloride, is further heated by an oxidising flame, and thus lower oxides of iron and the like are partly oxidised, in consequence of which the oxides become less soluble in acids. The same method is applicable for the cleansing and concentrating of natural or artificial phosphates, especially such as contain lime uncombined with phosphoric acid. If such phosphates contain carbonate of lime, the latter must be rendered caustic by burning.—J. T.

Extraction of Dangerous Compounds of Lead, Arsenic, etc. W. H. Tooth and J. E. Rooker, London. Eng. Pat. 7977, May 20, 1884.

The object of the invention is to remove volatile compounds in such a manner as not to be injurious to the workmen. The ore, etc., is heated in a retort connected with a series of condensing pipes, which are partially exhausted by means of a steam jet. Superheated steam or air may be passed into the retort.—J. T.

Utilising Phosphoric Slag. E. Capitaine, London. Eng. Pat. 8890, June 12, 1884.

The author finds that phosphoric slag liberates ammonia from ammoniacal salts in the form of gas, just as lime does. This discovery he utilises by using phosphoric slag in the place of lime in the ammonia-soda industry, and in all cases where lime may be used for the liberation of ammonia. The slag is used in the raw state; it is advisable to break it into small pieces, but during the process the pieces become completely disintegrated. When the slag is so exhausted as not to expel any more ammonia, the excess of bases that it contains passes into solution as salts corresponding to the ammoniacal salts. The residual slag still contains the whole of the phosphoric acid. The further treatment of this enriched material offers no difficulty.—J. T.

Separation of Ores and Mineral Products. F. J. King, London. Eng. Pat. 15,027, November 14, 1884.

This invention relates to the separation of substances which are partially magnetic, or have been made so by previous treatment. These substances are passed underneath a cylinder of iron bars, which are alternately magnetised and demagnetised, by which the magnetic material is removed from the non-magnetic.—J. T.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Method for the Purification of Mineral Oils. C. Roth, Berlin. Ger. Pat. 30,786, June 17, 1884.

In order to free mineral oils from substances which are liable to resinify so as to make them suitable for lubricating purposes, etc., from 1 to 5 per cent. of potassium permanganate are added previous to the process of distillation, which is conducted slowly. The distillate is first treated with sulphuric acid of 1·53 to 1·6 sp. gr., and then with caustic soda of 1·4 sp. gr. The treatment with potassium permanganate, sulphuric acid and caustic soda is once repeated. Mineral oil purified in this manner possesses a slightly yellow colour, with a green fluorescence, and after three days' exposure to air at 35° C. exhibits but slight signs of the formation of resinous bodies.—F. M.

Improvements in Cooling Apparatus for Cooling Oleine and other Liquids. A. Kind, Venice. Per W. P. Thompson & Co. Eng. Pat. 9072, July 2, 1884.

By means of suitable machinery and an arrangement of concentric cylinders, the liquid to be cooled, and the refrigerating medium, are made to move in opposite directions on either side of a partition, to which ribs are attached in order to increase the length of path travelled by the liquid to be cooled. Drawings are given.—W. L. C.

Improvements in the Process of Extracting Fat from, and drying Bones and the like. F. Seltsam, Bavaria. Per W. P. Thompson. Eng. Pat. 10,208, July 16, 1884.

In the ordinary extraction processes, difficulties arise from the presence of water in the bones. The patentee proposes to overcome these by the use of a solvent (usually a hydrocarbon from petroleum, etc.), the boiling point of which considerably exceeds that of water. The temperature in the extraction being raised by steam above 100° C., the water is expelled from the bones, and the extraction of the fat is more complete. The quality of the gelatin and crushed bones ultimately produced is said to be much improved.—W. L. C.

Improvements in the Manufacture of Soap and Saponaceous Compounds. S. N. Dimbleby. Per Tongue and Birkbeck. Eng. Pat. 11,305, August 15, 1884.

The juice of the plant *Hamamelis Virginica*, or common Wych Hazel, is mixed with soap, and with various compounds for toilet purposes which contain soap. Such compounds are said to be beneficial in the case of bruises and lacerations of the skin.—W. L. C.

An Improved Process for Extracting Oil and Albumenoid from Maize and other Grains. Dr. F. V. Greene, Philadelphia, U.S.A. Per Allison Bros. Eng. Pat. 3101, March 10, 1885.

The so-called "starch milk," which is a by-product in starch manufacture, contains an emulsion of oil and of the albumenoid matter of the grain. The patentee proposes to separate these substances from the water, rendering the latter innocuous, and producing valuable substances. Various methods are proposed—filtration, precipitation by various salts and acids, but notably by sulphate of alumina. From the mixed products, partly dried, the oil is separated by a solvent, and the albumenoids are used as fertilisers. The method is also applicable to the residues left after distilling spirit from corn.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Compositions for Protecting Iron Surfaces from Damp and Corrosion. J. Brydson, Kingston-on-Hull. Eng. Pat. 9105, June 17, 1884.

Three compositions are applied to the surface to be protected, which is first cleared from rust and scale. The first composition used is a varnish consisting of linseed oil, magnesia, sugar of lead, and litharge, heated and mixed while hot with a solution of resin in turpentine. After the mixture has cooled, zinc oxide and

calcium hydrate are added, and the whole is allowed to stand for several days before use. The next composition is a liquid gum consisting of alcohol, copal gum, dragons' blood, sugar of lead, beeswax, and turpentine; and the final composition consists of carefully-sifted wood powder, calcined wood powder, and umber, made up with water and calcium hydrate, and stove-dried. This can be at once applied over the gum, and the surface will then be ready for receiving paint or other decoration.
—E. G. C.

XIV.—AGRICULTURE, MANURES, Etc.

Influence of Certain Salts on Nitrification. P. Pichard. Bied. Centr. **14**, 152-156.

THE experiments were made on coarse and on fine sand of the composition here indicated, mixed with earth-nut cake, in quantities such as to give N = 0·15 per cent. of the mixture.

	SOLUBLE IN AQUA REGIA.				INSOLUBLE.
	Fe_2O_3 and Al_2O_3	CaO	MgO	K_2O	
Coarse sand	1·300%	0·068%	0·025%	0·007%	98·600%
Fine sand...	0·100	0·050	0·020	0·005	98·825

	Total N	Nitric N	K_2O	Total Ash.
Earth-nut cake	...7·700%	...0·029%	...1·250%	...4·400%

Each of the following salts were added to separate portions of this mixture in quantities approximating to the actual proportion generally found in soils. The salts employed were the carbonates and sulphates of potassium, sodium, calcium, and magnesium. In two cases no salts were added, and in two other experiments the earth-nut was replaced by ammonium sulphate on coarse sand, mixed with calcium and magnesium carbonate respectively. These mixtures were made up on the 30th May, 1883; they were placed in glass vases, with a layer of glass fragments below and a layer of pure sand on the top; they were kept moistened with distilled water, and were sheltered from rain and dust. On August 30 slight nitrification had taken place in the ammonium sulphate mixtures, but not in those containing earth-nut. The author attributes this formation of nitric acid to simple atmospheric oxidation. On August 31, to start nitrification, each mixture was seeded by the addition of about 0·75 per cent. of soil. At the close of the experiments, March 15, 1884, the mixtures were heated to 70° to arrest nitrifying activity, and were then analysed, the quantity of nitric acid being estimated by Boussingault's indigo method. In the coarse sand series the percentages of the total nitrogen nitrified were as follows:—In the mixture containing potassium carbonate 4·96, sodium carbonate 2·14, calcium carbonate 26·15, magnesium carbonate 24·47, potassium sulphate 12·59, sodium sulphate 15·61, calcium sulphate 28·82, magnesium sulphate 3·94, and where there was no salt added, 3·54; whilst in the fine sand the corresponding percentages of total nitrogen nitrified were potassium sulphate 20·86, sodium sulphate 24·96, calcium sulphate 46·29, magnesium sulphate 11·55, and with no salt added, 4·86. In the mixtures containing ammonium sulphate the percentage of nitrogen nitrified was with calcium carbonate 3·86, and with magnesium carbonate 3·18; in both these cases the remainder of the ammonia had disappeared, presumedly by volatilisation as carbonate. With regard to the adaptability of the salts for aiding nitrification, the author arranges them in order of merit indicated by the above analytical numbers, heading the list with gypsum. He explains the special activity of the latter substance by the supposition that in the presence of organic matter it is readily reduced, then by contact with air is re-oxidised, and in this manner acting as a conveyer of oxygen it aids nitrification.—D. A. L.

Loss of Nitrogen during Fermentation of Farmyard Manure. H. Joulie. Bied. Centr. **14**, 158-163.

SIX mixtures of 75grms. of chopped straw and 50grms. of dry powdered horse droppings were taken and soaked with 300cc. putrid human urine, and 275cc. of water; the solid materials contained in a suitable glass vessel were supported on iron wire-gauze; the liquid filtering through was poured over the mixtures every two or three days. No. 1 received nothing in addition, No. 2 received 10grms. phosphorite, No. 3 10grms. phosphorite and 10grms. gypsum, No. 4 10grms. phosphorite and 10grms. calcium carbonate, No. 5 10grms. of calcium carbonate, No. 6 10grms. gypsum, whilst a 7th mixture was composed as follows: 150grms. straw, 200grms. horse excrement, 400cc. urine, and 850cc. water. After 6½ months there were only traces of humic acid found in Nos. 3 and 6; 0·92 to 0·96 per cent. of the organic substance employed in Nos. 2, 4 and 5, whilst Nos. 1 and 7 contain 1·3 to 1·4 per cent. Complete analyses of mixtures 1 and 7 showed the manures were similar to fermented farmyard manure, allowing for difference caused by use of human urine instead of that of cattle. The losses of solid matter per cent. in each case were as follows:—

Mixture	1.	2.	3.	4.	5.	6.	7.
Losses ...	53·71	57·92	49·74	56·35	58·00	52·61	56·20

Whilst the losses per cent. of nitrogen are indicated by the following analytical data:—

Mixture	1.	2.	3.	4.	5.	6.	7.
Losses......	18·04	21·08	39·00	31·27	40·60	33·98	21·26

These numbers were obtained by analysis of both the liquid and solid matter; nitrogen as ammonia, as nitric acid, and in organic combination being estimated in all cases. In all cases there was a large decrease in ammoniacal nitrogen, ranging from 50 to 85 per cent.; and a large increase in organic nitrogen, from 35 to 63 per cent. On the other hand, the nitrogen as nitric acid only appeared, and then only in small quantities, in the mixtures 3 and 6, where gypsum had been added, which mixtures, it will also be observed, were almost free from humic acids. Apparently, then, much of the ammoniacal nitrogen is rendered insoluble by becoming organic, whilst much of it is lost. This is shown below:—

NITROGEN AS AMMONIA, PER CENT. OF THAT INTRODUCED.

Mixture	1.	2.	3.	4.	5.	6.	7.
Disappeared...	49·96	49·47	71·43	61·40	70·41	67·34	85·30
Transformed ..	24·82	20·09	11·09	17·83	13·84	19·98	44·54
Lost............	25·14	29·38	54·34	43·57	56·57	47·36	40·76

This loss of ammoniacal nitrogen would probably be larger in the great heaps in the farmyard, where the temperature much exceeds that obtained in these experiments; this is indicated by the greater loss in No. 7, where the composition was similar, but the mass and surface exposed were greater than in mixture 1. The loss is probably by volatilisation as ammonium carbonate, or perhaps fermentative. It is evident that gypsum and chalk, either alone or otherwise, increase the loss of nitrogen considerably.—D. A. L.

Presence of Amylase in Leaves. L. Brasse. Bied. Centr. **14**, 169-170.

THE author has found amylase in all leaves he examined, including potato, dahlia, maize, turnip, tobacco, castor-oil plant, etc.; also in poppy, pink, sun-flower, and castor-oil seeds. It was extracted by Dubrunfaut's method. The leaves or seeds were bruised in a mortar, macerated for twenty-four hours in cold water, pressed, and the solution mixed with one-and-a-half times its volume of 90 to 93° alcohol and filtered. A similar quantity of alcohol was added to the filtrate, and the precipitate which contains the amylase was collected on a filter and washed with 65° alcohol. To prove the presence of the amylase in the precipitate, 0·5grm. starch, 20cc. water, and 10cc. of an aqueous solution of the amylase, which quantity corresponded to 10grms. of fresh leaves, were placed in small flasks, and along with other flasks, containing the amylase solution alone, were kept in a water bath at a temperature of 63°, and the reducing sugar estimated by difference. Eight to ten drops of chloroform were added to each flask, and they were then closed with corks. Microbes were not detected in the solutions; in all cases the starch was converted into a reducing sugar and dextrin.—D. A. L.

Poisonous Effects of Arsenic, Lead and Zinc on Vegetable Organisms. F. Nobbe, P. Baessler, and H. Will. Bied. Centr. **14**, 175-183.

YOUNG and healthy growing plants were introduced into nutritive solutions to which varying quantities of potassium arsenite had been added; in many of the experiments the quantity of arsenic added in this form amounted to 0·003, 0·033, 0·333, and 1·0grm. per litre. In all cases control cultivations were conducted with similar plants without arsenic. With the arsenic the plant withers and fades, the older leaves first, then the stem; it then recovers slightly, especially if removed to a fresh non-poisonous solution, but only to sink again and finally perish. The rapidity of this poisonous action increases with the strength of the arsenic solutions, but it also depends to some extent on the kind of plant. Peas and oats succumb quicker than maize and shrubs. Following the order of strengths given above, peas perish either in twelve, four or three days respectively. The quantity of arsenic taken up by the plant is very minute. The roots always contain more than the other parts of the plant. Many other experiments tend to show that the root is the vulnerable point; for instance, comparative arsenic cultivations were conducted in the dark in moist atmospheres, and in the light in the ordinary atmosphere. In the former case the action of the arsenic was retarded,—showing, firstly, that the roots were attacked more than the above-ground growth; and, secondly, that the transpiration or absorption faculty was effected in some way. The following experiment illustrates the latter effect:—Young alder plants were set in solutions containing 0·0003 arsenic per litre, and observations of transpiration and absorption were made every two hours during the day. After the first two hours the plant had only absorbed 40 per cent. of the normal quantity of water, and throughout the experiment the transpiration almost always exceeded the absorption, hence the plant lost in weight, and after three days, when the plant was almost dead and the experiment ended, this loss amounted to 19·2 per cent. When analysed in this condition, the dry matter of the root contained 0·008 per cent. arsenic, whilst the other part of the plant contained only 0·0029 per cent. Solutions containing only one per million of arsenic are still injuriously active, and the harmless limit of dilution has not yet been reached. The arsenic apparently attacks the protoplasm of the roots, impeding their osmotic action, and consequently diminishing the quantity of water absorbed. Similar experiments with lead and zinc demonstrate that these metals are extremely injurious to plants, whether presented in a soluble form as nitrates or in an insoluble form as carbonates; even if they are present in such small quantities that the plant appears healthy externally, their deleterious action is evident in the diminished yield of the plant. Zinc is more poisonous even in form of carbonate, than lead, and is also taken up by the plant in much greater quantities than the latter metal is. Solutions containing one-thousandth part of zinc kill plants (peas) in three days, whilst solutions of lead containing similar quantities produced a similar effect in eleven days. (See Action of Zinc Salts on Plants, this Journal, iv. [6], 408).
—D. A. L.

Detection of Fungoid Spores and Putrefaction Germs in Cattle Foods. A. Emmerling. Bied. Centr. **14**, 212-213.

SMALL quantities of the materials made into a thin magma with water are introduced into clean glass tubes, using all necessary precautions against the introduction of foreign organisms. After being heated for twenty-four hours at 35° C., the contents of the tubes are examined microscopically. This method, when worked with care, has been found to give concordant results, and is therefore regarded as satisfactory for the detection of mould-spores, etc. Samples of sesame cake and earth-nut meal were found to be free from fungoid-spores, whereas rice meal was found full of them. With regard to bacteria, sesame cake contained bacilli and sometimes mycoderma; and earth-nut cake and rice meal, micrococci and bacilli.—D. A. L.

Improvements in the Treatment of the Lupinus (Lupine) to adapt it for use for Cattle. Emil Capitaine, London. Eng. Pat. 10,495, July 23, 1884.

THE object of this invention is to extract from the lupinus the bitter principle which renders it unsuitable for use as a cattle food, without at the same time impairing its nourishing properties. The plants are first kiln-dried at a temperature not exceeding 70° C., and then placed in water at a temperature ranging between 65° and 85° C. If the temperature be lower than 65°, part of the albumen is dissolved and lost for feeding purposes; if higher than 85°, a considerable portion of the proteïd matter is rendered insoluble.
—E. G. C.

XV.—SUGAR, GUMS, STARCHES, Etc.

The Position of Sorghum Saccharatum in Agriculture and the Sugar Factory. E. Szechenyi, jun. Bied. Centr. **14**, 186.

MINNESOTA amber-cane (sugar-cane) was cultivated in Hungary, and the produce treated for sugar in the American fashion. When the seed was sown before the end of April, the plants developed to complete ripeness, but seeds sown later did not ripen. The yield per joch was 115·7metr.centr. of canes, 14·65 of seeds and stalks, 6·60 of cane-leaves. The 115·7metr.centr. of cane gave 34·55 of green sap; and the syrup obtained from the sap by means of milk of lime, etc., when concentrated contained per cent. cane-sugar 52·10, invert sugar 28·62, water 15·74, ash 1·95, non-saccharine matter 1·50, which by centrifugalising yielded a brown cane-sugar containing over 80 per cent. of crystalline sugar. The dried seeds and stalk had the following composition (water 14·3%):—

Fat.	Albumenoids.	Non-nitrogenous nutritives.	Woody fibre.	Ash.	Sand.
3·25......	11·20......	80·25......	3·25......	1·95......	0·10 = 100

—approximating to that of barley. The pressed canes when fresh are eaten by cattle, but not by sheep; when treated otherwise, cattle will not consume them without they are previously mixed and warmed with chaff, straw, and water. According to the author, sorghum is not an exhausting plot for the soil.—D. A. L.

Extracting Sugar from Molasses and Saccharine Solutions. Jünemann. Bied. Centr. **14**, 216.

FOR this purpose the author recommends the use of a certain soluble magnesium hydroxide; it forms an insoluble magnesium saccharate, which, when decomposed with carbonic anhydride, yields pure sugar. The mode of preparing the hydroxide is not given.—D. A. L.

Improvements in Purifying or Clarifying Sugar, and in Apparatus therefor. Eugen Langen, London. Eng. Pat. 10,367, July 19, 1884.

THIS invention relates to the process of purifying sugar by washing out the molasses from the crystallised sugar by means of pure syrup. It differs, however, from the ordinary process in that it is continuous, the sugar being made to traverse the apparatus in one direction, whilst the syrup with which it is washed moves in the opposite

direction. Hence the pure syrup comes into contact with nearly pure sugar, and, as it becomes more and more impure, it meets also with less pure sugar. Special apparatus in which to carry on the operation is described.
—A. J. K.

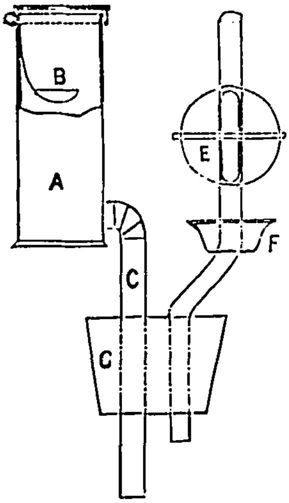
XVI.—BREWING, WINES, SPIRITS, Etc.

Cultivated Wine Yeast. A. Rommier. Bied. Centr. **14**, 203-204.

In previous communications the author has shown that the addition of cultivated wine yeast to must from different varieties of grapes accelerates fermentation at relatively low temperatures, and produces wine quicker than the natural fermentation would do; moreover, the cultivated wine yeasts, without previous sterilisation of the must, prevents secondary fermentation, which would spoil the wine. The present experiments were conducted during warm weather, hence the accelerating effect was not observed; anyway, the yeast prevented the development of deleterious germs, therefore it exerts a preservative influence on the wine, and in cold weather increases the rapidity and regularity of fermentation.
—D. A. L.

Apparatus for the Treatment of Wine with Sulphurous Acid. J. Nessler, Carlsruhe. Ger Pat. 29,590, May 13, 1884.

The cylindrical vessel A, made of tin plate and lacquered, contains an iron spoon B, and is furnished with a pipe C. When in use the apparatus is by means of the cork G fixed upon the vessel in which the sulphurous acid is to act. Some spirit is then poured into the copper vessel F (partly filled with sand or asbestos) and set on fire; the sulphur contained in the spoon B is, after previous heating of the latter, likewise set on fire and again put into A.



The air in the ball E is heated by the burning spirit, and thus causes a draught, which supplies the sulphur with air and causes the sulphurous acid to pass into the vessel where it is wanted. In this manner sulphurous acid can be used for killing the mould and mycoderma-vini or -aceti plants in an empty or partly full cask, in which otherwise the sulphur would not burn.—F. M.

Improvements in Making an Extract and Beverages from Clover. J. Walker, Leeds. Eng. Pat. 8916, June 13, 1884.

The dried clover is chopped and mashed in water; the extract so obtained is boiled with hops, and the liquor therefrom treated with citric, tartaric, or acetic acid, afterwards with a little carbonate of soda to neutralise the excess of acid, and then fined and filtered. The golden-coloured liquid so obtained is made into a syrup with sugar, and may then be used for the production of an aërated or non-aërated beverage, or used to flavour other liquors. It may also be added to malt worts previous to fermentation, producing a beer of a fuller character and less intoxicating. It is also valuable as an anti-scorbutic.—C. C. H.

A Process for the Continuous Distillation and Rectification of Alcohols, or other Volatile Substances, and Apparatus for the Purpose. J. C. Mewburn, London. From E. A. Barbet, Nord, France. Eng. Pat. 9397, June 25, 1884.

The improved process involves the employment of a distilling column or purifier in which the ethers are separated first from the alcoholic solution, and a rectifier in which the alcohol obtained in the purifier is further submitted to distillation. Both columns resemble each other in construction, and differ only in proportion of parts. The liquid undergoing distillation is first heated in the lower part of the column by the heat of the condensed material running from the column, and is then introduced into the column at the top, and in its descent undergoes fractionation, the ether condensing and collecting at the bottom, whence it runs to a receiver, and the alcohol passing to a condenser, and from thence to the second column, where it is similarly treated to the liquid in the first column. The process of distillation is therefore continuous with the operation of rectification. The interior of each column is fitted with shelves and cups, in a manner similar to the shelves usual in stills. The claims are: (1) for the process of continuous distillation, (2) for the apparatus, (3) a specially constructed shelf and cup.—C. C. H.

An Improved Method of Converting the Juice of the Jerusalem Artichoke into Levulose, and the Application of the latter for Obtaining Various Products by Fermentation and Distillation. A. M. Clark, London. From E. L. J. Boniface, Paris. Eng. Pat. 10,686, July 28, 1884.

The synanthrose and inulin contained in the tubers of the artichoke can only be partially converted into alcohol by distillation, various essential oils being also formed at the same time. The object of this invention is to prevent the formation of the essential oils, and to secure the maximum amount of alcohol. The tubers are pulped, and afterwards treated with a mineral acid and heated; the whole of the sugar-yielding substances being thus converted into levulose. The quantity of the acid is from 0·0005 to 0·005 of the weight of the juice, and the small excess of the acid does not necessitate the neutralisation of the juice before undergoing fermentation. A syrup may also be made by concentrating the juice in the same way as in the concentration of glucose syrups; the patentee points out that it differs essentially from glucose syrup, and consists only of levulose, and is not a mixture of dextrin and glucose. A beer may also be made in the manner usually pursued, but in this case a mineral acid must not be used.—C. C. H.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

Improvements in the Preservation of Meat Extracts. F. Walton, Twickenham. Eng. Pat. 16,376, December 12, 1884.

Mainly consist of processes of varnishing the external surfaces of the skins enclosing the essences or other meat preparations.—E. G. C.

Effects produced by the Sulphurous Acid of the Atmosphere of Towns. G. Witz. Bull. Soc. Ind. Rouen, **13**, 161.

Attention has been directed to the marked diminution of the quantity of atmospheric ozone during the recent epidemic of cholera in France. The observations taken at Paris and Marseilles, the results of which were communicated by M. Onimus to the Academy (December 15, 1884), clearly indicate a correlative bearing of the quantity of ozone upon the fluctuations of the epidemic. At Marseilles, during the month of July, the mean quantity was 0·86, as against 2·17 in the preceding year. In Paris, the mortality was at its height during the fortnight ending November 15, and the mean proportion of ozone during that period was 0·27, as compared with 2·00 for the corresponding period of 1883. Commenting upon these figures, in their purely chemical aspect, the author points out a factor of the results which has been hitherto ignored—viz., the sulphurous anhydride proceeding from the combustion of coal and coal-gas, the quantity of which in large towns must be very considerable. The necessary destruction of ozone by this gas is the explanation advanced by the author of the definite variations of the proportion of ozone observed at Montsouris, with variations in the direction of the wind. The report furnished by this observatory for 1884 states that with the winds from south to west the proportion of ozone is large; but from south-west, through north to east-south-east, the quantity is small. Observations extending over seven years show a constant minimum coincidently with the prevalence of north winds. The position of Montsouris to the south of Paris suggested to the author the influence of the atmosphere of large towns upon the ozone of the air; and in considering this influence, *à priori*, the part played by sulphurous acid appeared to be probably the most important agency in the destruction of the active oxygen.

Some Constituents of Rain Water. Chairy. Bied. Centr. **14**, 209.

Rain water collected at the Meteorological Observatory of Algiers, was examined throughout the year, and the following substances determined:—Sodium chloride was present in quantities varying from 17·4 to 52·6 per million, iron as oxide or carbonate from 0·7 to 7·8 per million, whilst the quantity of ammonium nitrite varied from 0·14 to 0·29 per million, whereas of ammonium nitrate only traces were detected, and in two cases none at all. Neither iodine nor hydrogen peroxide were detected in a litre of water.—D. A. L.

A New Method or System of Treating Acid Waters to Purify them. B. Littlewood, Huddersfield. Eng. Pat. 8047, May 22, 1884.

A cistern is packed with a mixture of substances containing lime or its carbonate, potash or silica. Materials recommended are burnt clay, oyster shells, and a lime mortar carbonated by exposure to the air. The water is caused to rise through a mass of such material, and to flow over through a pipe at the top of the cistern. —C. C. H.

An Improved Mixture for Disinfecting, Deodorising, and Antiseptic Purposes. G. R. Tweedie, London, and Hartins Crimson Salt Company, Limited, Worcester. Eng. Pat. 9538, June 28, 1884.

The improved mixture is formed of one or more of the manganates or permanganates of the alkali metals, one or more alums, chloride of sodium or potassium, borax or other combinations of the alkali metals with boric acid. Such a mixture is said to be more powerful for the purpose set forth than any of the components alone. The following proportions are given as yielding good results:—Potassium permanganate, 1 ounce; potash alum, 8 ounce; borax, 1 ounce; common salt, 6 ounce. The proportions may be varied with equally good results. The compound may be applied in the usual way in the form of powder or as a solution, in which case it is much more powerful.—C. C. H.

Improvements in the Treatment of Sewage or Foul Waters, or other Solid and Liquid Impurities or Foul Matters, for the purpose of Deodorising the same, and for the Prevention of the Formation of Sewer Gas. J. Hanson, Wakefield. Eng. Pat. 9587, June 30, 1884.

To effect the deodorisation of sewage and matters of a similar nature, the patentee proposes to add a solution of the waste product known as "black-ash waste." The drainings from waste heaps may also be used with an equally good effect. The "decoction" may be prepared by the addition of 28lb. of the waste to 100 gallons of water. The deodorisation is stated to be effected by "the vapours or vapourisable matters becoming fixed, and they cannot afterwards decompose."—C. C. H.

An Improved Compound for Disinfecting. H. B. Condy, Battersea. Eng. Pat. 10,015, July 10, 1884.

This invention deals with the production of permanganate of alumina for use as a disinfectant, this salt having the advantage of yielding, for the purpose of oxidation, five-sevenths of the oxygen it contains. In 1000 parts by weight of a solution of sulphate of alumina, containing one-third of its weight of the sulphate, 53 parts of permanganate of potash are dissolved by heat; the mixture is allowed to cool, and the potash alum formed crystallises out, leaving the permanganate of alumina and the excess of the sulphate of alumina in solution. The proportions given above may be varied, but those stated are the most convenient. In some cases where the solution is intended to be used quickly, it may be found advantageous to add the equivalent quantity of sulphuric acid instead of the sulphate—say, 1 part of acid for each 7 parts of the sulphate of alumina. —C. C. H.

Improvements in Apparatus or Means to be employed in effecting the Softening or Purification of Water and for other Purposes. H. Porter and J. H. Porter, London. Eng. Pat. 10,459, July 22, 1884.

This invention has for its object an improved method of supplying automatically the solution of lime to the hard water undergoing treatment by the Clark process, and is an improvement upon former patents taken out by one of the present patentees. The lime water is admitted into a vessel containing an indiarubber or flexible bag, which bag is afterwards distended by water, admitted under pressure, and thus forces out the reagent into the vessel in which the admixture with the hard water is effected.—C. C. H.

An Improved Process of Deodorising, Disinfecting, Precipitating, Drying, and Pulverising the Solid Portions of Sewage to render it a Marketable Manure. W. Astrop, Tottenham. Eng. Pat. 11,901, Sept. 2, 1884.

The precipitation of the sewage is effected in tanks in the usual way with a combination of sulphate of calcium, carbonate of alumina, sulphate of potash or soda, and finely-ground ashes. The reagent is obtained by mixing milk of carbonate of lime with sulphate of alumina, or soda of potash alum; "carbonate of alumina" is formed, the calcium carbonate is transformed into hydrated sulphate of calcium, and the potash or soda salts remain as their respective sulphates. After the precipitation is effected, the sludge is collected from the tanks and discharged on to a travelling band which passes over vacuum boxes, the water thereby being removed to a considerable extent. The partially-dried sludge is then passed through rollers, where a further quantity of moisture is removed. The cake passes on the same band, and is discharged into a revolving drum formed of open wire-work, through which a current of hot air is drawn by a fan or other means, the dried sludge finally being discharged through the meshes of the drying cylinder ready to be bagged as a manure.—C. C. H.

Improvements in Filtering Compounds and in the Construction of Filters for Industrial and other Purposes. C. E. Chamberland, Paris. Eng. Pat. 3423, March 17, 1885.

The filtration of water, especially that used for domestic purposes, is effected through a medium composed of pipe clay and porcelain clay, the proportions of which may vary. The mixture is moulded into the desired shapes, and baked at a temperature of 2400° F. The apparatus consists of a number of tubes made as above described, and placed in the interior of a cylindrical vessel into which the water is forced; it filters through the tubes into the lower part of the apparatus effectually purified. Three claims are made for the compound as described and the apparatus.—C. C. H.

Destroying and Utilising Sewage in Buildings, Towns, and Cities. A. Engle, Metz, Iowa, U.S.A. Eng. Pat. 4046, March 31, 1885.

To effect the objects described in the title, the patentee proposes to collect the excreta, both solid and liquid, in a vessel in connection with the pan of the closet, etc., from whence it falls, on the opening of a suitable valve, into a retort. When the retort is charged the whole is submitted to destructive distillation; the gaseous bodies are collected into a pipe and passed through the furnace surrounding the retort, so that they are not only effectually destroyed, but also afford heat for the distillation of the contents of the retort itself.—C. C. H.

Improvements in Processes for Treating Sewage and other Waste Waters for obtaining the Fats, Fatty Acids, and Fibrous Matter contained in the same, and in Apparatus to be employed therewith. W. H. Beck, London. From H. Wagener and Professor Dr. A. Müller, Berlin. Eng. Pat. 4207, April 2, 1885.

The object of this invention is the extraction and utilisation of fat, grease, cellulose and fibrous matter from sewage. The sewage is first settled in a tank in order to deposit the sand and heavy ponderable matter, after which it is passed through an apparatus described in the specification at great length. The operation is as follows:—The sewage water is led through a succession of pipes to a receptacle where the remainder of the fine sand is settled out and carried away by a screw in the lower part of the U-shaped tank. From this tank the liquid passes into a conical screen, where the coarser fibrous matter is intercepted, and delivered on to a travelling band, which carries it from the machine, to be treated as described further on. The finer fibrous matter is then taken out by a travelling wire-work screen, provided with brushes, and delivered into a tank at the end of the machine. The liquid sewage passing from the machine is treated with lime or any other process, and the fine mud collected, and after treatment by an acid to liberate the fat from the lime soap formed, is shaped into cakes in a filter press, and treated with any suitable solvent to extract the grease. The fibrous matters are finally treated in a similar manner to obtain the fatty matters, and the residue made into paper or coarse card-board.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Decomposing Metallic Haloid Salts by Electrolysis. C. Hoepfner, Berlin. Eng. Pat. 6736, April 23, 1884.

In the electrolysis of haloid salts of the light and heavy metals, especially those of the alkalis, the difficulties resulting from polarisation have hitherto hindered an advantageous application of electricity on the large scale. The present process consists chiefly in preventing polarisation by the use of depolarising substances at the cathode, or by circulation of the electrolyte. It is thus possible to decompose chlorides, and to utilise the chlorine therein. Thus, to prepare by electrolysis from any chloride, the chlorine required for the extraction of metals, a conducting substance which cannot be attacked by chlorine, such as carbon or manganese ore, is used as an anode in the solution of the chloride, this solution being caused to continually flow in and out at the same, whereby the chlorine liberated is carried away. According to the speed of flow of the liquid, so can it be more or less saturated with chlorine. To avoid the separation of hydrogen at the cathode, the latter, which may consist of any conducting material, is surrounded with a substance which prevents polarisation; such substances are those which are reducible by hydrogen. The salt lyes, charged with chlorine, by this method may be employed for the extraction of silver and gold. The chloride lye is first saturated with chlorine at the anode, then mixed with auriferous ore and reduced at the cathode, and then returned to the anode for a fresh charge of chlorine. Other applications of the process are indicated.—J. T.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements in Sulphite Wood Pulp. S. Pitt, Surrey. England. From R. P. Pictet and G. L. Brélaz, Switzerland. Eng. Pat. 9509, June 27, 1884.

The chief points of interest in this specification are:—(1) The use of supersaturated aqueous solutions of sulphurous acid gas, having a gaseous tension of from 5 to 6 atmospheres at a temperature below 100° C. (2) The use of a vacuum for mechanically removing the air contained in the wood, to facilitate the penetration of the acid liquid into the fibres, (3) Employing temperatures below 100° C., in order to avoid the decomposition of the resinous, etc., incrusting matters in the wood. (4) "Re-utilising the solutions from the boilers, and recovering a large portion of sulphurous acid gas contained in these liquids." (5) Preparation of "gums, resins, tannin, alcohol etc.," from the solutions of incrusting matter. Attention is drawn to the fact that the high temperature which it is essential to employ with sulphites of soda, etc., cause the formation of particles of tar or pitch which penetrate the fibre, and render bleaching laborious and very costly. The washings, etc., which then become essential, much injure the whiteness of the product; the yield is reduced, and the strength of the fibre impaired by the repeated action of bleaching liquor. When the wood is sufficiently boiled, the acid solution contains a number of different products, of which the following are the principal: (1) A large proportion of gums, resins, and glucose from the incrusting substances and essential oils of wood. (2) Sulphate of lime in small proportion. (3) Almost the whole of the sulphurous acid. "The bleaching by chloride of lime is preceded in this manufacture by the action of sulphurous acid, which diminishes very considerably the cost of this operation."—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Method for the Preparation of Quinoline Disulphonic Acids. N. La Coste, Aachen. Ger. Pat. 29,920, April 20, 1884.

The mixture of the two isomeric monosulphonic acids obtained by the treatment of quinoline with fuming sulphuric acid, is heated with the double quantity of fuming sulphuric acid to 200-240°. From the product the sulphuric acid is separated in the usual manner, the disulphonic acids are converted into the potassium salts, and separated by repeated crystallisation; potassium α-quinoline disulphonate being the more soluble one. By melting the potassium or sodium salts of the quinoline disulphonic acids with about 3 parts caustic potash or soda at 180-200°, the salts of the corresponding oxyquinoline sulphonic acids, $C_9H_5N.SO_3H.OH$, are formed. By increasing the quantity of caustic alkali to 5 parts for 1 of quinoline disulphonate, and raising the heat to 290-310°, dioxyquinolines, $C_9H_5N(OH)_2$, are formed. In order to separate the α-dioxyquinoline, which is the principal product of the reaction, the melt is carefully neutralised with hydrochloric or sulphuric acids, and the α-dioxyquinoline extracted by means of ether. By evaporating the neutral or slightly-acid solution of the melt to dryness, the dioxyquinoline or its salts can also be extracted from it by alcohol, wood-spirit or similar solvents.
—F. M.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Method for the Estimation of Free Sulphuric Acid in Vinegar. B. Kohnstein. Dingl. Polyt. J. **256**, 128.

100cc. of vinegar are neutralised with the necessary quantity of pure magnesia, and filtered. From 25cc. to

30cc. of the filtrate are evaporated to dryness in a platinum basin. The residue is gently ignited until all the magnesium acetate is decomposed. Water containing carbonic acid is then added, and the whole again evaporated to dryness, in order to render the magnesium carbonate formed during the process of ignition more granular, as in this state it is easier to wash. The magnesium sulphate is extracted from the carbonate by means of hot water. After separating the small quantity of lime which may happen to be present in the filtrate, the magnesia contained in it is estimated as pyrophosphate. From the quantity of the latter the quantity of free sulphuric acid contained in the vinegar may be calculated. The author gives the results of some analyses of mixtures of pure dilute acetic and sulphuric acids of known composition, which testify to the value of his method. The small quantities of magnesium salts usually occurring in vinegar may influence the results, but the error is so slight that it may safely be neglected.

—F. M.

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

8190 J. C. Mewburn, London—Communicated by F. C. E. Simon, France. Improvements in evaporating, distilling, and refrigerating apparatus. July 6

8225 H. C. Paterson, Glasgow. Improvements in smoke-consuming furnaces. July 7

8301 T. C. Fawcett, Halifax. Improvements in machinery for making saggers, crucibles, and similar moulds, also applicable to the moulds of brick-making machines. July 9

8353 A. E. Robinson, Edgbaston. Improvements in appliances for producing and condensing vapours. July 10

8527 W. R. Lake, London—Communicated by J. W. Hyatt, United States. Improvements in filtering apparatus. July 11

8615 R. Kullig, London. Improvements in Royle's condensation apparatus. Complete specification. July 16

8630 E. Edwards, London—Communicated by L. Rohrmann and M. Hiller, Germany. Improvements in apparatus for effecting the absorption of gases or vapours by liquids. July 16

II.—FUEL, GAS, AND LIGHT.

7581 E. Capitaine and O. Brünler, London. Improvements in the production of compressed gaseous compound for use in gas motors and for other purposes, and apparatus therefor. Complete specification. June 22

7615 J. D. Bodwell, London. Improvement in apparatus for the combustion of liquid fuel. Complete specification. June 23

7613 L. A. Groth, London—Communicated by F. Garavagnoe & Co., Italy. A new or improved gas carburetting apparatus. June 23

7791 S. Butler, London. Improvements in apparatus for mixing and heating materials for the manufacture of patent fuel. June 26

7815 R. Dempster, Manchester. Improvements in the construction of stand pipes for gas retorts. June 27

7893 T. G. Marsh, Failsworth, Lancashire. Improvements in gas-lighting and heating. June 30

8005 W. A. McIntosh Valon, London. Improvements in machinery or apparatus for the manufacture of compressed artificial fuel. July 1

8097 H. J. W. Raphael and J. Syme, London. Improvements in means for preventing nuisance from smoke, and for utilising the gaseous products of combustion from furnaces or the like for lighting or other purposes. July 3

8516 T. Chappell and C. H. Adames, Blackstock Road. Improvements in the manufacture of fuel. July 14

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

7563 A. M. Clark, London—Communicated by A. Cozé, France. Improvements in retorts for the distillation of coal and other solid matters, and in apparatus connected therewith. June 20

8181 L. T. Wright, London. Improvements in or connected with the hydraulic mains used in the distillation of coal. Complete specification. July 6.

IV.—COLOURING MATTERS AND DYES.

7491 H. J. Haddan, London—Communicated by Dr. R. Worms, Saxony. A new manufacture of blue colouring matter. June 19

7630 C. E. Avery, London. The improved manufacture of extracts and liquors of logwood. Complete specification. June 23

7731 L. Heffter, London. Drying alizarin and dissolving it afterwards. June 25

7811 H. H. Lake, London—Communicated by Wirth & Co., agents for A. Liebmann, Germany. Improvements in the manufacture of naphthylamine sulpho-acid. June 27

8211 T. Frusher, London. Improved manufacture of ink from waste dye liquors. July 7

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

8143 A. Whowell, London. Improvements in apparatus employed for bleaching purposes. July 13

VII.—ACIDS, ALKALIS, AND SALTS.

7514 G. H. Bolton, Liverpool. Improved fastening device applicable to, or improvements in, heads and lids or covers of caustic soda or other drums, etc., in which a nearly cylindrical part is required to be quickly fastened and loosed. June 20

7657 E. W. Parnell and J. Simpson, Liverpool. Improvements in the separation of sulphuretted hydrogen from nitrogen. June 24

7691 R. T. Freeman, London. An improvement in nitrous oxide gas or other compressible gases or gas bottles. June 21

7831 T. Capper, London—Communicated by Dr. S. Pick, Austria. Improvements in apparatus for making bicarbonate of sodium. June 27

7841 O. N. Witt, London. A process for the manufacture of hydrochloric acid adapted to be used in connection with the ammonia soda process. June 27

7867 A. Brin, London. Improvements in the manufacture of bioxide of barium and its use in making oxygenated water for bleaching or for other purposes. June 29

8071 C. C. Springer, Manchester. Improvements in the manufacture of sulphurous acid gas (SO_2), and in the apparatus employed in such manufacture. July 3

8191 B. J. B. Mills, London—Communicated by J. M. Duncan, United States. Improvements in means or apparatus employed in the manufacture of salt from brine, and in producing strong brine for the manufacture of soda ash, and other chemicals. July 6

8260 T. Robinson, Glasgow. Improvements in the manufacture of alum and sulphate of alumina. July 8

8301 T. B. Saunders and A. V. Saunders, Bradford. Improvements in the method of, and apparatus for, generating dry hydrochloric acid gas for the carbonisation of vegetable matter mixed with wool and woollen rags. July 9

8382 H. Richardson, Jarrow-on-Tyne. Improvements in the manufacture of hydrate, sulphate, and other salts of alumina. July 11

8392 W. P. Thompson, Liverpool—Communicated by B. Osann, Germany. A new or improved process of manufacturing caustic alkalis during the purification of iron by the Thomas-Gilchrist process. Complete specification. July 11

8410 E. W. Parnell and J. Simpson, Liverpool. Improvements in obtaining sulphuretted hydrogen from sulphide of ammonium. July 13

8470 F. Maxwell-Lyte, London. Improvements in the production of chlorine and apparatus therefor. July 13

8499 W. Allen, London. Improvements in acid taps and valves and seats for chemical works. July 11

8511 H. Leplay, London. Improvements in decarbonating the carbonates of strontia and baryta, and in apparatus therefor. Complete specification. July 11

8602 N. Glendinning, Liverpool. Improvements in the treatment of copper liquors. July 16

8623 S. H. Johnson and C. C. Hutchinson, London. Improvements in preparing milk of lime, and in apparatus to be used therefor, and for other such like purposes. July 16

VIII.—GLASS, POTTERY, AND EARTHENWARE.

7937 C. C. Thompson, London. Improvements in machines for making pottery, glass-ware, and articles of all kinds from soft plastic materials which are capable of being moulded. Complete specification. June 30

8551 W. P. Thompson, London—Communicated by C. Potts and A. Potts, United States. Improvements in machinery applicable for finely dividing and tempering clay. Complete specification. July 15

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

7912 W. B. Smith, London. Improvements in binding bricks and other building blocks. June 30

8153 W. P. Thompson, Liverpool—Communicated by R. Bosse and F. Wolters, Germany. Improved process for rendering cements hydraulic, that is to say, capable of setting and hardening under water. July 6